Introduction and Purpose of Project

Until new and innovative power generation technologies become available, coal-fired generation will continue to play a major role in supplying the energy needs of this country. All told, fossil-steam plants generate more than 70 percent of all electric energy in the country and these aging plants, on average more than 30 years old, will remain the foundation of the power industry for the immediate future.

While the Intermountain Generating Station is still one of the newest and most modern large coal-fired generating stations in the country, it is now exceeding 20 years in service and some of the components and equipment are starting to show signs of that age. With no foreseeable end to the need for the power from this station, it is imperative that we take any prudent measure available to maintain the reliability and efficiency for which this facility is well known and upon which its economic future depends.

With that imperative in mind, this project was developed - Availability Improvement Project. The project had five objectives:

1. **System Criticality Assessment:** Evaluate and identify the plant systems that, by design, have the highest potential for negatively affecting availability of IGS, ICS and STS.

2. **Assessment of Condition Monitoring:** Evaluate the available methods for monitoring the condition of the systems and equipment both on and off-line.

3. **Assessment of Maintenance Plans and Methods:** Evaluate the current and available methods, plans, and programs for maintaining the systems, subsystems, and individual pieces of equipment.

4. **Critical Spare Parts Evaluation:** Evaluate what critical parts are necessary for each system and piece of equipment.

5. **Plan for Future Renewals and Replacements:** Plan for future renewals and replacements by identifying them as far ahead as possible.

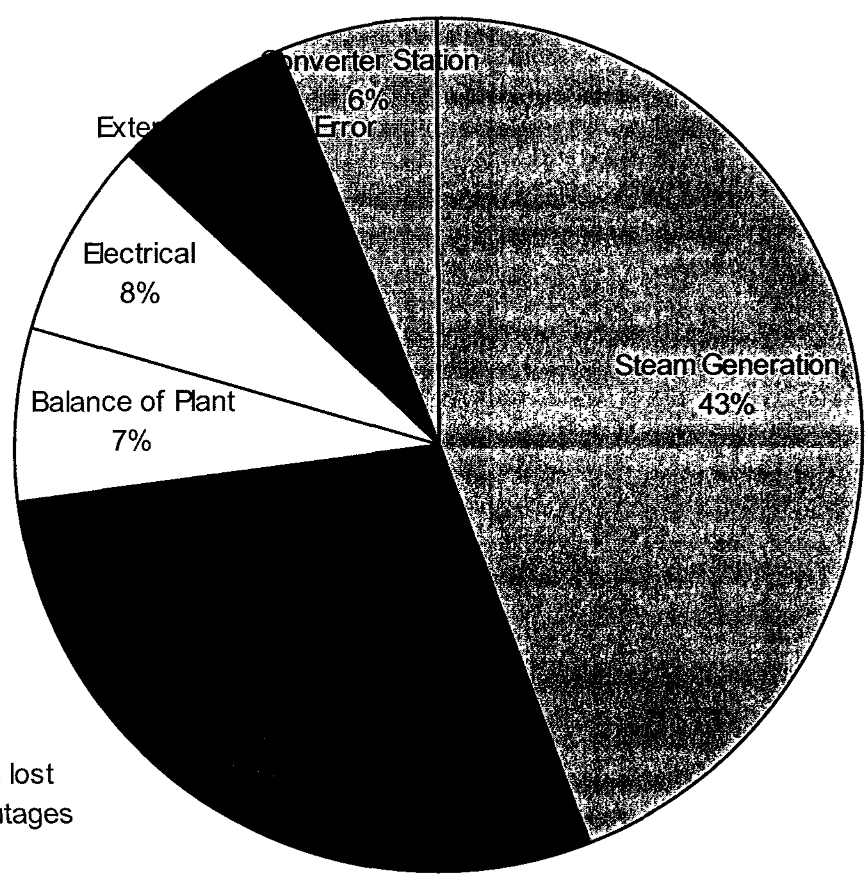
None of these objectives in and of themselves are new or different from what we have been trying to accomplish at IGS since the plant went on-line. In fact, it has always been our objective to maintain the plant in "As-New" condition and much effort has been expended toward that means over the years. Nevertheless, organizations can become entrenched in their modes of doing things and IPSC is not immune to this form of unintentional complacency.

The hope for this project was to rekindle innovation and imagination among the experienced personnel of this plant upon whom we so much depend but, also upon whom may be becoming myopic in their viewpoint by the long years of service.

Historical Losses of Availability

The first step in this process was to look at the historical losses of availability for the station to determine which pieces of equipment or systems have caused the highest number of forced outages or derates over the approximate 20 years of service. The graph below shows the losses by major pieces of equipment.

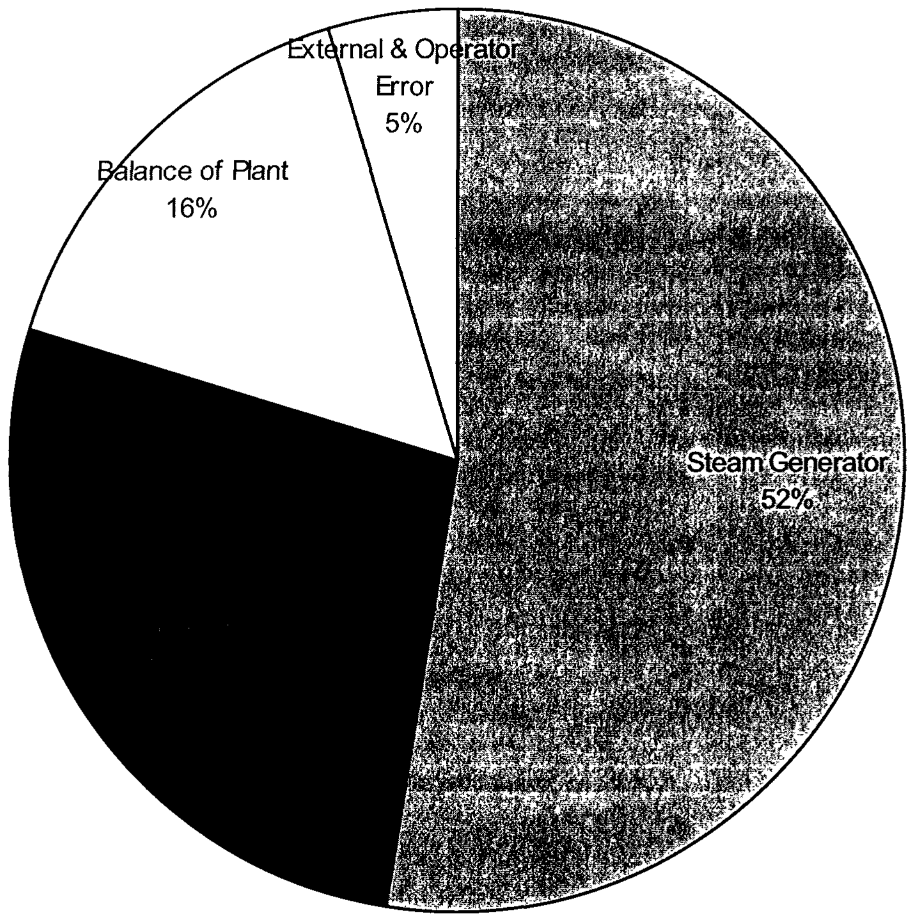
IGS
Loss of Availability by Major System



Includes all generation lost except for Planned Outages and Planned Derates.

As would be expected, the boiler or steam generator has historically had the largest impact on availability followed by the Turbine-Generator. Clearly, boiler reliability is the deciding factor in the economic viability of this facility and is the major factor in ensuring high capacity factors.

NERC-GADS Fossil Steam Plant Data
(1995-1999, All Unit Sizes, All Fuels, Average size approx. 300 MW)



In a 2002 publication (*Productivity Improvement Handbook for Fossil Steam Power Plant: Third Edition, 1006315),* EPRI published some availability numbers for all fossil fuel plants across the country. The results are published above. As you can see, these numbers compare very similarly with the experiences at IGS. EPRI did not break out electrical systems from the balance of the plant so no direct comparisons could be made in that area.

Rationale for Critical Systems

In order to focus this project on the systems most affecting reliability, the different plant systems and subsystems were categorized by overall impact on plant availability. The goal was to assign a Criticality Factor (CF) for each plant system or subsystem. This system was similar to one used by LADWP right after initial construction to review the spare parts and maintenance needs for the plant. The categories used were as follows:

CF 1 = Equipment failure causes 100 percent load loss immediately. No Redundancy.

CF 2 = Equipment failure causes partial load loss immediately. Redundancy not capable of 100 percent output.

CF 3 = Equipment failure causes no load loss. Redundancy capable of 100 percent output.

CF 4 = Equipment failure causes only inconvenience. All other process equipment not directly tied to production.

For this project, only CF 1 and CF 2 systems will receive a detailed analysis. Some analysis was also done of the coal yard even though it was deemed to have been CF 3 because of redundancy. This does not mean that the other plant systems are not important or necessary, we are just trying to focus this detailed review and analysis on those pieces of equipment that have or are most likely to cause losses of generation.

The factors used for determining the appropriate CF were, historical events, design redundancy, part availability, repair time, accessibility, and experience-based intuition.

The list of systems assigned CF 1 or CF 2 are attached at the end of this section.

Project Implementation

This report will be just a bunch of words without a plan and the follow-up to make something positive happen. Lofty objectives like these cannot be achieved by any one department or group, it has to be done as a team effort with the support of management and the project owners. The value of the efforts will only be realized if improvements in availability can be achieved and maintained over long periods of time.

The actual implementation of this project will be in five steps:

1. Complete a critical systems assessment to determine which plant systems and equipment should be analyzed. This has been completed.

2. Hold availability improvement meetings with key plant personnel for each of the five areas outlined in this report. The purpose of the meetings will be to identify possible changes to the predictive maintenance programs, maintenance schedules, spare parts needs, and to suggest possible future capital improvements. This has also been completed.

3. Perform detailed analysis of the suggestions received from the availability improvement meetings. The analysis should include estimates of the cost of implementation and economic benefits and should rank the suggestions on the potential impact to availability. Management and owner support should be obtained for those projects that will be taken to full completion.

4. The list of approved recommendations should be tracked with regular status updates. Schedules should be developed for each recommendation. Where needed, the recommendations should be budgeted on either the capital or O&M budget.

5. Create Availability Improvement Working Groups for each of the five major plant areas outlined in this report:

   - Steam Generator
   - Turbine-Generator
   - Electrical
   - Balance-of-Plant
   - Converter Station

   These Working Groups should incorporate the key personnel from all of the plant departments. They should meet as needed, but no less than twice per year to review the recent events that affected availability, to perform failure analysis, discuss plans for future capital improvements, and to develop suggestions for improvement in any Maintenance or Operational activity.

   The results from these meetings should be added to the tracking lists, evaluated and monitored similar to the way the original suggestions are being handled.

This report covers only the activities of Steps 1 and 2. All other activities will be reported on at a later date.

Steam Generator Systems

Description of Systems

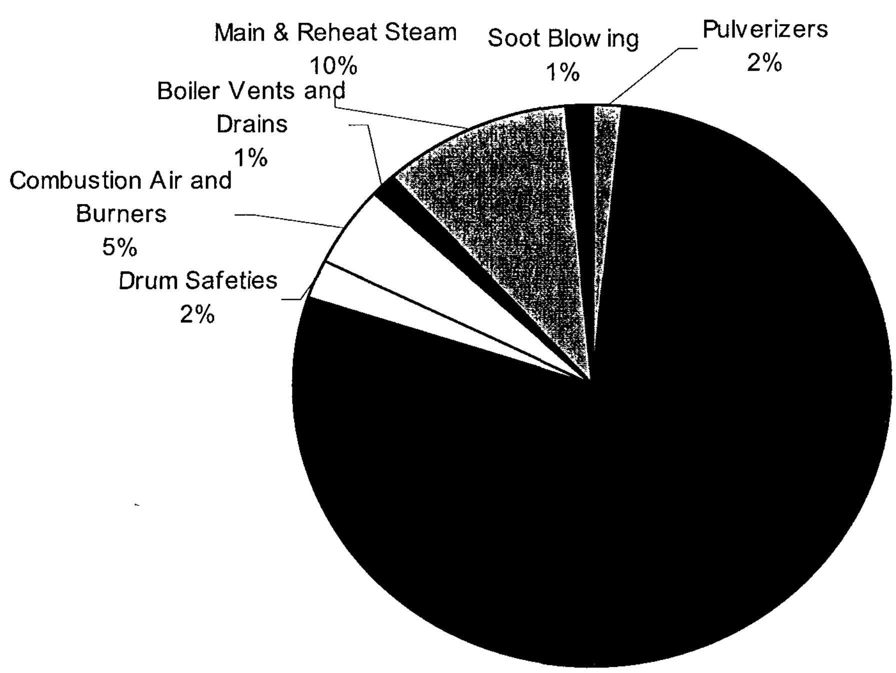
The Steam Generator System consists of the Boiler, Main Steam, Reheat Steam, Pulverizers, Combustion Air Supply, and all other subsystems necessary to generate the steam for the Turbine-Generator. For this analysis, Steam Generator, consisting of subsystems determined to be Criticality 1 or 2, were reviewed by a committee of those personnel who are responsible for these systems.

The following System Codes were analyzed with the Steam Generator Systems:

Plant System	System Code
Steam Generator	SGA
Combustion Air Supply	SGB
Boiler Vents and Drains	SGF
Main Steam	SGG
Burner and Mill Controls	SGH
Soot Blowing	SGI
Reheat Steam	SGJ

Steam Generator Losses by Subsystem

(Percentage of all Steam Generator Losses of Equivalent Availability)



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Losses of Availability

Historically, the Steam Generator Systems have attributed to 44 percent of the total losses of availability for the station. IGS experiences compare very similarly to NERC-GADS data for unit downtime with the average for plants greater than 300 MW from 1995 to 1999 being 52 percent of all losses of availability. IGS is also similar to NERC-GADS with the majority of outages being caused by Boiler tube leaks (79 percent). The second largest cause of loss of availability is Main and Reheat Steam (10 percent) with most of those incidents being caused by safety valves. All other systems account for the remaining 11 percent of losses.

Some of the key statistics gathered from an analysis of the IGS historical data:

	Unit 1	Unit 2	Station
Number of events caused by Steam Generator Systems	136	130	266
Percentage fo all events caused by Steam Generator Systems	27.5%	30.1%	28.7%
Number of forced outages caused by Steam Generator Systems	33	34	67
Percentage of all forced outages caused by Steam Generator Systems	21.0%	24.3%	22.6%
Equivalent hours of lost generation caused by Steam Generator Systems	1691.1	1551.2	3242.4
Percentage of all equivalent hours of lost generation caused by Steam Generator Systems	45.9%	41.2%	44.0%

Boiler Tube Failure Reduction Program

From the initial startup of IPP, IPSC has pursued an ambitious condition assessment program for the Steam Generator and ancillary equipment. This program is designed to minimize both the average annual outage rate associated with steam generator pressure component failures (primarily tube leaks) and in minimizing the length of the respective outages.

The Boiler Tube Failure Reduction Program has yielded excellent results for the past 18-plus years at IGS. However, as the units age, the number of tube failures is trending upward. Vigilance in adhering to established standards and continuous efforts to improve the program will be necessary to maintain this high level of performance into the future.

IGS Performance Compared to Other Coal-fired Units of Similar Size

Compared with the most recent data (published January 2005) from the NERC-GADS Industry Database, the IGF units consistently out-perform the industry average when it comes to both the average number of tube-leak related outages and the average duration of respective outages. The following table summarizes these numbers compared to similar coal-fired units in the 800-1000 MWg range. Included as an attachment to this report are detailed charts showing yearly tallies for each unit in each of the categories below for each year since start-up.

	NERC-GADS 5-year Average	Unit #1 5-year Average ('00 to Present)	Unit #2 5-year Average ('00 to Present)	IGS 5-year Average ('00 to Present)
Number of tube-leak related Outages/year	3.39	1.9	1.23	1.3
Hours per Outage	174.21	102.11	57.14	64.1

On the average, IGS has managed to hold down both the number or tube-leak related outages and the outage duration to nearly 1/3 of the industry average for 18 years. However, the number of tube leaks on both units has started to climb in recent years. This is an indication of not only the increasing age of the units but of the need to improve efforts to eliminate failures. The key to reducing BTFs is to identify the failure mechanisms and take action to mitigate or eliminate the root causes.

Historical BTF Mechanisms

IGS Units have experienced 47 tube failures (combined) in the past 18-plus years. A brief treatment of the top three categories of failure mechanisms, and other considerations will follow as outlined below:

- Attachment-weld Failures
- External Erosion
- Short-term Overheat
- NO Water Chemistry-related tube failures
- Other Mechanisms of Concern

Attachment-weld Failures

More than 20 percent of all tube failures at IGS have resulted from failure of dissimilar-metal welds at the hanger-lug attachments in the vertical section of the Reheat Superheater. Other failures of this type include cracks at membrane welds where the side-wall connects to the furnace sloped floor and similar cracking at the paddle-tie bars in the corners of the furnace and at the convection-pass front wall, side wall, floor connections. These are all high stress areas. Failures are related to expansion/contraction design issues.

External Erosion

This category includes the mechanisms of Soot-blower Erosion and Flyash Erosion. Although soot-blower erosion is extensive in both units, most soot-blower related failures have resulted from soot-blower failures; failure to retract. Flyash erosion is a relatively new mechanism at IGS. Recent fuel changes have increased the ash loading through the boiler which has accelerated erosion.

Short-term Overheat

Short-term overheat normally results from restricted steam flow through the tubes. Restrictions have included weld wire, slag, exfoliated oxide, possible water blockage at start up, and most recently, a hinge pin from a check valve that made its way to a super heater inlet manifold. The ubiquitous use of chill rings, or backing rings in the weld joints of the superheater and reheat superheater tubes has provided numerous opportunities to collect debris.

NO Water Chemistry-related Failures

The discussion of tube failure mechanisms at IGS would not be complete without trumpeting the fact that plant chemists have maintained excellent water chemistry in the boilers. In more than 18 years, neither unit has experienced a chemistry-related failure.

Other Mechanisms of Concern

Although long-term overheat (creep) has not been an issue at IGS, the units are aging and both units exhibit the typical uneven temperature profile from side to side through the superheater sections. As a result, some overheating is expected. Both of these facts make this a mechanism to watch for in the future.

Most weld and material defects should have manifested themselves by this point in the life of the units. However, cracking due to mechanical and thermal fatigue will increase as time marches on. Again, vigilance is called for.

Considerable effort has been expended in the past to mitigate and eliminate many of the concerns above. A few examples of past efforts follow in the next section.

Efforts Taken to Eliminate BTF Mechanisms

The current inspection plan for the IGS units is designed to ensure that each major component of the boiler is inspected at least once every 6 years (3 major-outage cycles). However, experience has proven to be the best guide as to where to concentrate the inspection resources. Unit 2 has a much better BTF record, in part, due to lessons learned on Unit 1. A few examples follow:

- Reheat Superheat Support Lugs
- Paddle-tie bars
- Lower Furnace Wall-to-Floor Connections
- Lower Waterwall Header Issues
- Convection Pass Arch

These are areas where numerous tube failures resulted from over-stressed connections. Failures in these areas have been reduced due to increased inspection frequency and scope, and by making alterations to relieve residual stresses.

Soot-blower damage has been reduced by forming a dedicated soot-blower crew to improve the consistency of maintenance. Soot blower pressure settings have also been optimized to find a balance between maximizing cleaning efficiency and minimizing damage. Damage maps are used to track wastage rates, and of course, tube shields are employed in troublesome areas when possible.

Flyash erosion is mitigated by careful attention to tube alignment in pendant elements and shielding/baffling is employed where needed.

It is difficult to combat short-term overheat; but, preemptive radiographic examination of lower tube bends and small diameter chill rings have been employed in the past to mitigate this mechanism.

Long-term overheating is monitored with internal oxide thickness measurements in the highest temperature areas of the pendants. Base-line data is compared to more recent readings with Larsen-Miller analysis to estimate remaining life. Replication at welds, particularly on the penthouse headers is used to spot creep in the early stages.

A more comprehensive oxide thickness survey is under consideration that would allow us to identify the tubes operating at the highest temperatures and consequently allow the installation of flow balancing hardware at the outlet headers to balance tube temperatures across the boiler.

Future efforts to minimize tube failures will be guided primarily by:

- Manufacturer recommendations
- Historical failure experience
- Internal inspection results
- Time in-service
- Location in the steam generator
- Type of material
- Operating temperature and pressure
- Design and operating stress loads

As man-power and budgetary resources are limited, efforts will be prioritized to areas that represent the highest risk of equipment damage and the most likely sources of tube-failure related outages.

Recommendations

Recommendations are classified into four main areas; Maintenance, Predictive Maintenance, Capital Projects, and Critical Spare Parts. Some of the main points are discussed below. Please refer to the complete list of recommendations for the Steam Generator Systems in the appendix. The following are the most significant items the committee felt were of greatest value to ensure continued high availability of the station. They are listed in order of the area of evaluation and not in order of importance.

Maintenance Improvements

Chill Rings for Dissimilar Thickness Tube Welds

One of the most difficult welds to complete in the boiler is one involving different thicknesses of tube materials. This can be assisted by the proper application of chill rings to hold and center the different tube materials. A Maintenance Instruction (MI) should be developed on the proper use of chill rings

Purchase Tube Bending Machine

Purchase of a tube bending machine and dies. An increase in tooling is necessary to prepare for tube leaks in areas of the boiler that have not as yet been a problem. There are many areas of the boiler that have tight radius bends in tubes. It is necessary that we are able to perform these bends for replacement of the failed tubes. An alternate plan would be to stock pre-bent tubes of all sizes needed.

Recommended Capital Projects

Replace Electromatic Relief Valves and Controls

Replace Electromatic Relief valves and controls with up-to-date technology. When these valves do not operate properly it causes the other relief valves to open. Past history has shown that the other relief valves have a history of not closing tightly after actuation. This has been a cause of lost load. It is necessary to restrict main steam pressure when these valves are "gagged" or schedule a Unit outage for the repair of these valves.

Add Drum Safety Valve

Addition of one Drum safety valve. The addition of one Drum safety valve would enable the Unit to stay at full load and pressure when one of the other safety valves has been "gagged" due to leak by.

Replace Sootblower Thermal Drains and Controls

Replacement of the sootblower thermal drain valves and controls for these valves. These valves limit the amount of moisture in the sootblowing lines. Upon start up of a sootblower, it is important that no water is present in the sootblowing lance as it starts into the boiler. The presence of water when the sootblower inserts into the boiler will mix the water with fly ash and increase sootblower/fly ash erosion in that area. This repeated occurrence will lead to boiler tube leaks.

Recommended Changes in Predictive Maintenance

Increase Boiler NDE and Inspection

Increase NDE and inspection of specific areas of the boiler. The back pass area of the boiler in the Horizontal Superheat section is an area that needs additional access for inspection. A need for a door in the back of the boiler on the middle section of Superheat tubes is necessary for the inspection of the tubes located in this area.

Recommended Additional Critical Spare Parts

FD Fan Hydraulic and Lube Oil Pumps

We have a spare rotor, motor, and most other parts in the event there is a major failure but, we do not have spare hydraulic and lube oil pumps. An evaluation should be done on the cost, availability, and risk of failure of one of these pumps. The loss of an FD Fan would be a significant derate to the facility.

PA and FD Fan Speed Changer

Both the PA and FD fans utilize two-speed motors for control and operation. We maintain a spare motor but, we do not have spare speed change switches. These switches are unusual and difficult to obtain.

Assessment of Spare Tubing

Assessment of spare tubing. It is necessary to have all of the tubing available for repairs when a tube leak has occurred. This will be addressed in several ways.

1. Determine tube needs based on history and location of probable tube leaks.
2. Establish minium stocking requirements of pre-bent tubing for specific areas of the boiler and investigate the feasability of an assured stocking program with a vendor.

Turbine Generator Systems

Description of Systems

The turbine is a tandem-compound reheat unit consisting of a single-flow high pressure section, *a double-flow reheat section, and three double-flow low pressure sections originally supplied by* General Electric. The high pressure section in both Units 1 and 2 was replaced in March 2003 and March 2002 respectively with Alstom rotors, diaphragms, and inner casings as part of a performance upgrade. The last low pressure section is coupled to a two-pole, hydrogen cooled generator rotor designed for continuous operation. This system includes all supporting auxiliary equipment.

The following System Codes were analyzed with the Turbine Generator Systems:

Plant System	System Code
Turbine	TGA
Generator	TGB
Turbine Seals and Drains	TGC
Turbine Lube Oil	TGD
Generator Cooling and Purge	TGE
Turbine Controls EHC	TGF

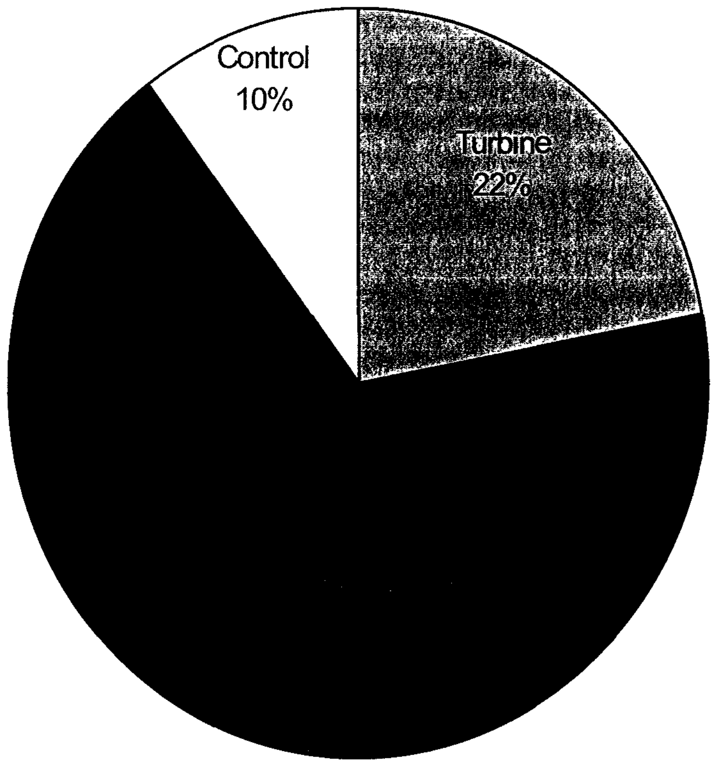
Losses of Availability

Statistics for the Turbine Generator System gathered from an analysis of the IGS historical data:

	Unit 1	Unit 2	Station
Number of Events Caused by Turbine Generator Systems	51	48	99
Percentage of All Events Caused by Turbine Generator Systems	10.3%	11.1%	10.7%
Number of Forced Outages Caused by Turbine Generator Systems	25	25	50
Percentage of All Forced Outages Caused by Turbine Generator Systems	15.9%	17.9%	16.8%
Equivalent Hours of Lost Generation Caused by Turbine Generator Systems	737.7	1391.73	2129.4
Percentage of All Equivalent Hours of Lost Generation Caused by Turbine Generator Systems	20.0%	37.0%	28.9%

Turbine Generator Losses by Subsystem

(Percentage of all Turbine-Generator Losses of Equivalent Availability)



It is significant to note that of the total 2,129.4 hours of generation loss in this system, 53 percent (1,130 hours) is attributable to the failure of the pole-to-pole jumper on the main generator field on Unit 2. The main field required a complete rewind, and extended the scheduled 1996 outage by 47 days.

There was no one type of incident that caused the majority of forced outages that originated from the turbine-generator. The most repetitive incident was failure of the turbine Electrical Trip Test system which accounted for fourteen of the fifty forced outages. The Electrical Trip System is being replaced as part of the plant DCS upgrade which should address that problem.

<u>Generator Reliability</u>

The generator is the heart of any power plant and an unexpected failure of the generator can result in months, or possibly years, of downtime. There are many known failure mechanisms in a generator, some electrical in nature and some mechanical. Most are difficult, if not impossible, to monitor or check on a regular basis. Some of the major concerns with generator reliability are:

- Field Turn-to-Turn Shorts
- Leaking Stator Bars and Insulation Integrity
- Field Pole-to-Pole Jumper Cracking
- Hydrogen Seal Integrity
- Stator Wedge Tightness

The biggest concern of all of these is leaking stator bars and insulation integrity. Capital Project IGS03-05 was originally developed to insure continued reliable operation of the generators. The original scope of the project included purchasing a spare stator winding and replacing the exciters for both units.

The spare stator winding was scheduled for purchase first because of recommendations from General Electric and continuing problems with the hydraulic integrity of the winding. However, because epoxy repairs fixed many of the initial leaks and biannual testing of the stator windings indicated this problem was progressing slowly, the replacement of the exciters was moved up in the schedule. The exciters became a higher priority because of the lack of replacement parts and technical support for the existing systems.

In addition, in the Spring of 2005, the Unit 1 generator field developed a turn-to-turn short. This short limits the reactive capability of the generator due to vibration caused by thermal sensitivity of the field rotor.

The money originally allocated to purchase spare stator bars will be used to rewind the Unit 1 field. A separate capital purchase was submitted, for the 2007-2008 budget, to purchase the spare stator winding.

The current schedule for generator modifications is:

Complete Tuning of New Unit 2 Excitation System	Spring 2006
Replace Unit 1 Excitation System	Spring 2007 Outage
Rewind the Unit 1 Generator Field	Spring 2007 Outage
Purchase of Spare Stator Winding (multi-year)	July 2007 - June 2008

The generator excitation system replacement and spare stator winding project, IGS03-05, was developed to maintain the reliability of the generators.

The original project budget included:

System Studies and Specification Preparation	2003 - 2004	$ 85,000
Purchase and Install Unit 1 Excitation System	2004 - 2005	$3,760,000
Purchase and Install Unit 2 Excitation System and Purchase Spare Stator Winding	2005 - 2006	$7,560,000

The revised budget includes:

Unit 1 Excitation System	2006-2007	$3,000,000*
Unit 1 Field Rewind	2006-2007	$2,000,000
Spare Stator Winding	2007-2008	$5,000,000

* includes $2,000,000 carried over from the 2005-2006 because of late equipment deliveries.

We started reviewing the performance of the generator stator windings based on a TIL (technical information letter) from General Electric in 1991. Early on, we determined we had a significant problem with the hydraulic integrity of the stator windings. Global epoxy repairs of the windings in 1996 (Unit 2) and 1997 (Unit 1) significantly improved the winding integrity, but we continue to have problems passing the GE recommended vacuum and pressure tests on the stator winding.

After we started evaluating the reliability of the generators, it became apparent that within a few years we would need to replace the excitation systems on both units. The current generator excitation system is no longer manufactured by General Electric (GE). GE is still providing parts, as the components are available from their suppliers, but there is limited field support from personnel with Generrex experience. Recently, GE was unable to supply replacement bridge disconnect switches and field current transducers because of component obsolescence. We have had ongoing problems with drifting field current transducers, misaligned DC field circuit breakers, and intermittent connections on the bridge disconnects for both units. In addition, we have had intermittent control power supply grounds on the trip circuit bus on Unit 2. We currently stock critical spare parts for most of the Generrex controls, but we do not have any spare parts for the components in the generator dome.

There are less than 30 compound source Generrex systems in service and through discussions with other Generrex owners, it is apparent that continued reliable operation of these units is not feasible. After our evaluation, we decided to delay the purchase of the spare stator bars until after the Unit 2 exciter was replaced.

In 2005, a new concern was identified for long term reliable operation of the generators. Testing after the Unit 1 Spring 2005 outage indicated the field had developed a turn-to-turn short. This short was apparently causing thermal sensitivities in the field. The turn-to-turn short was discovered due to generator vibrations at varying field current conditions and was confirmed through flux probe testing. Plans were then made to rewind the Unit 1 field in 2007. In order to minimize impact to the capital budget, caused by the cost of rewinding the field, the stator bar purchase was postponed.

In 2006, at the start of the Unit 2 outage, additional flux probe testing was performed on both units. The Spring 2006 test on Unit 1 indicates there may not be a turn-to-turn short in the field. In the Fall of 2006, an independent consultant, GeneratorTech confirmed the presence of the turn-to-turn short. Based on these results, we plan to rewind the Unit field in the Spring 2007 Outage.

<u>**Recommended Capital, Predictive, or Maintenance Improvements**</u>

The following is a list of significant items recommended by the committee to ensure continued high availability of the station. They are listed in order of the primary system and not in order of importance.

Continue with industry standard nondestructive examinations of turbine rotors at scheduled outages.

All of the intermediate and low pressure turbine rotors have had boresonic inspections completed. Nothing of significance has been noted. The recommendation is to continue with boresonic inspections every 7 to 10 years. Boresonic testing has not been done on the Alstom high pressure turbine rotors. Additionally, ultrasonic (UT) examinations have been completed on the L-1, L-2, and L-3 wheel dovetails. UT testing has been completed on the L-0 finger dovetail pins as well. Physical measurements of the rotor bucket dovetail lifting have been taken on the L-0, L-1, L-2, L-3, L-4 and L-5 stages.

Review potential replacement and upgrade of the intermediate and low pressure turbine rotors.

The intermediate pressure (IP) turbine and low pressure (LP) turbine rotors should be reviewed for replacement based on design and metallurgy improvements. Replacement of the rotors would require performance and economic justification.

Upgrade turbine bearing pedestal monitoring system.

Pedestal heights on turbine bearings T-1 through T-11 are monitored using a system of Invar rods and proximity probes. The system provides valuable information on changes in bearing pedestal height useful when making decisions on turbine alignment. The system should be upgraded to include the latest technology and to include indication on the T-12 and T-13 bearing pedestals.

Purchase spare condenser expansion joint.

The connection between the LP hoods and the condenser consists of a stainless steel bellows expansion joint. The committee recommends the purchase of a complete replacement for at least one (1) condenser. This would include the purchase of four (4) corner pieces that require welding to the straight runs of expansion joint to complete the assembly.

Upgrade the generator core monitoring system.

The core monitoring system should be upgraded to the latest technology. New monitoring systems, such as Partial Discharge Analysis, should be evaluated for installation.

Purchase spare Main Seal Oil pump and motor.

The Hydrogen Seal Oil system includes the Main Seal Oil pump (MSOP), Recirc Seal Oil pump (RSOP), and the Emergency Seal Oil pump (ESOP). The MSOP is the primary source of sealing oil for the main generator and is critical equipment. The ESOP will provide emergency back up for the MSOP, however the committee feels it is prudent to have a spare MSOP available for quick replacement when needed. The same applies for the ESOP motor.

The EHC skid should be evaluated for upgrade and replacement.

The EHC skids have redundant 100 percent capacity pumps, and we also stock spare pumps in the warehouse. However, the pump and skid design itself should be evaluated and upgraded. New systems are available, such as a "Turbo-Toc" system, and should be considered for installation. Additionally, the stocking levels of EHC fluid should be reviewed and a 100 percent capacity change out should be considered.

Purchase and stock a spare Stator Cooling Water Pump.

The stator cooling water skid includes redundant 100 percent capacity cooling water pumps. The pumps can be replaced on-line and this has been done in the past. However, when one pump is out of service and taken to the shop for maintenance, all redundancy is lost. We stock parts to rebuild the stator cooling water pumps, but having a complete pump available for immediate installation when an in-service pump fails would reduce our chances of lost generation.

Install an additional auxiliary overhead crane on the main turbine deck cranes.

There are two (2) overhead bridge cranes used for turbine and generator maintenance. Each crane has a 95-ton hook and a 40-ton hook. The committee feels that some turbine repair work could be completed in a more expeditious manner if an additional crane, of smaller capacity and higher speed, could be installed on the existing bridges. Many of the lifts made during turbine repairs are well under the capacity of even the 40-ton crane. Having a smaller capacity crane available, in the 10- to 15-ton range, would aid Maintenance in completing turbine and boiler feed pump work.

Electrical Systems

Introduction and Description of Analyzed Systems

The continued safe and efficient operation of IGS facilities requires careful inspection and maintenance of numerous electrical systems at various voltage service levels. These systems operate in the background for the most part but are as essential to plant availability as the critical equipment served by these systems.

The intent of this section is to review critical electrical systems of the facility and to identify improvements that can be made to ensure their long term viability. Areas addressed and committee recommendations made are detailed in the pages that follow. The Converter Station electrical systems will be included in the Converter Station report.

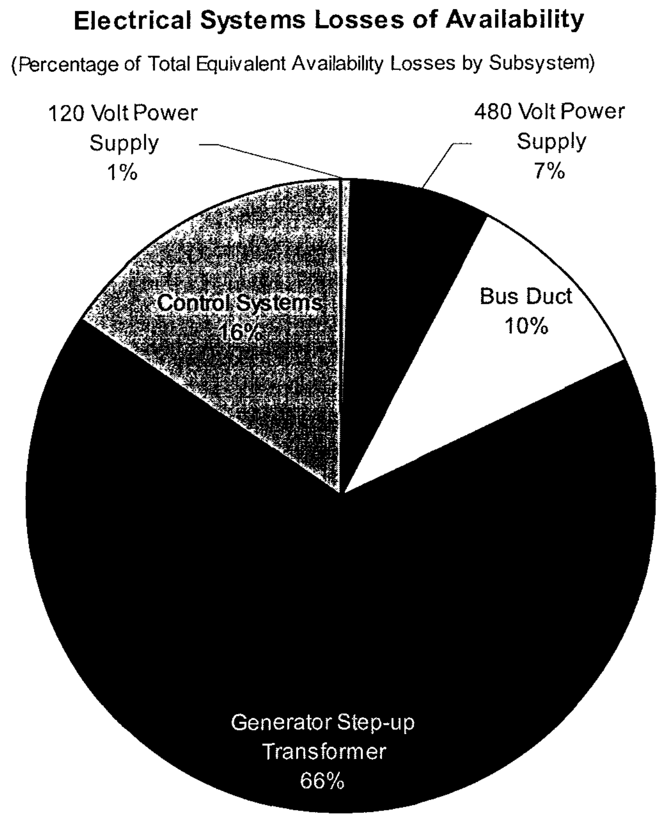
Electrical systems would generally be considered BOP systems by most definitions but, concerns over recent problems with electrical systems make it prudent to analyze the electrical equipment as separate systems to ensure they are given proper attention.

The following System Codes were analyzed with the Electrical Systems:

Auxiliary Power System (AP)	Subsystem Code
AC Power Supply (120v)	APA
AC Power Supply (480v)	APC
AC Power Supply (6900v)	APE
DC Power Supply	APH
Essential Service AC	API
Essential Service DC	APJ

Control System (CO)	Subsystem Code
Coordinated Control (DCS)	COA
Unit Protection	COC
Control & Multi-System Panels	COF

Generator Transformer System (GT)	Subsystem Code
Generator Bus Duct	GTA
Generator Transformer	GTB



Losses of Availability

Historically, the Electrical Systems have attributed to just under 8 percent of the total losses of availability for the station. Combine the BOP statistic of 7 percent with the 8 percent of the Electrical Systems to get 15 percent and you can compare the IGS experience with data reported in the EPRI report of 2002 . EPRI reported that BOP systems (including electrical systems) contributed to13.8 percent of all losses of availability which is very similar to IGS experience.

Statistics for Electrical Systems gathered from an analysis of the IGS historical data:

	Unit 1	Unit 2	Station
Number of Events Caused by the Electrical Systems	34	39	73
Percentage of All Events Caused by the Electrical Systems	6.9%	9.0%	7.9%
Number of Forced Outages Caused by the Electrical Systems	20	19	39
Percentage of All Forced Outages Caused by the Electrical Systems	12.7%	13.6%	13.1%
Equivalent Hours of Lost Generation Caused by the Electrical Systems	271.9	287.45	559.33
Percentage of All Equivalent Hours of Lost Generation Caused by the Electrical Systems	7.4%	7.6%	7.6%

Recommended Capital, Predictive, or Maintenance Improvements

Please refer to the complete list of recommendations for the Electrical Systems which are listed at the end of this report. The following are the most significant items the task force committee felt were of greatest value to ensure continued high availability of the station. They are listed in order of the primary system and not in order of importance.

Purchase and install transformer oil continuous dissolved gas analysis equipment on the Aux Transformer 1A, Aux Transformer 1B, and the Generator Step-up (GSU) Transformer in both units.

We currently sample the oil every six months and have it tested by Doble. Recent catastrophic events in the United States suggest the need for continuous monitoring. Several of the events occurred in a short time frame. Testing only at six month intervals may not uncover problems that could develop shortly after a test and escalate to destruction in just a few days or weeks without any indication. Estimated time to replace an Aux Transformer is six days. Estimated time to replace the GSU is two weeks.

Purchase and install a wet cell battery continuous monitoring system for the Essential AC and Unit Battery DC station batteries.

Currently the preventative maintenance consists of taking cell voltage and specific gravity readings quarterly along with visual inspections and load testing during outages when directed by Engineering. New technology has been developed to more thoroughly monitor wet cell battery systems. The system automatically monitors a group of parameters on all cells in a lead-acid storage battery system and alarms if any parameter of any cell exceeds specified limits.

Increase use of thermography technology to include scanning online of Generator Breaker, Switchgear, and other equipment.

Add viewing windows to switchgear lineups, iso-phase housings, and various loads to allow thermography scan with equipment in the operating condition. Windows of special material can be installed which retain the enclosure integrity yet allow infrared cameras to "see" through it.

Purchase and install replacement Essential AC Inverters in Unit 1.

Unit 1 inverter transformers are older than those in Unit 2. The equipment is obsolete and nearing the end of its useful life. Inverters removed from Unit 1 could be stored and used for spare parts to keep Unit 2 equipment in service. This was recently done in a similar manner to the Unit and Essential Battery Chargers.

Replace ABB Generator Breaker at the first opportunity. Order lead time is approximately 2 years.

Our generation of the ABB breaker was obsoleted in 1999. Parts availability is rapidly decreasing. When parts are available, they come at an extremely high price with long delivery. This project is currently planned for 2011 and 2012. This needs to be moved up because equipment is no longer supported. The breaker was manufactured in Switzerland.

Purchase and install infrared detection monitoring system on the Iso-phase Bus Duct.

This newer technology is specifically designed for uprated generators where bus work has not been upgraded. Information is available remotely. The information can be used to evaluate unbalance between phases. It can detect heat build-up generated from loose arcing connections. We have had a bus duct failure at IGS resulting in a forced outage of several days. This technology will allow us to know beforehand when a problem area is developing and can be resolved during normal planned outages.

Purchase and install new digital temperature monitoring system for Units 1 and 2 GSU Transformers.

The current Qualitrol system originally provided is obsolete. Current equipment does not have the accuracy of the new digital system. Maintenance calibration costs are higher. With the unit uprates to 950MW, the GSU runs near its thermal limit in the summer time. Close monitoring is essential.

Fully dress and test the spare GSU and Aux Transformers. Install bushings, bushing pockets, and CTs.

These two transformers are critical spares in the event of a catastrophic unexpected loss. The transformers were shipped unassembled and have been stored that way. The loose parts have been put in the Warehouse and used to service the installed equipment. In the worst case scenario of a catastrophic failure and fire, it is likely that nothing could be salvaged. Fully dressing the spares would make sure that all parts for a complete installation are on site. With bushings installed, it would further allow proper testing of the transformer periodically to ensure that the transformers are truly in a serviceable condition.

This would also require the purchase of replacement spare bushings and other loose materials for warehouse stock for maintenance of the existing equipment. If our only spare bushings, for example, are installed on the spare transformers, they would not be available for use during outages and other times when parts are changed on the transformer.

Electrical System Spare Parts Analysis

Please refer to the complete list of recommended spare part recommendations for the Electrical Systems. The following are the most significant items the task force committee felt were of greatest value to ensure continued high availability of the station. They are listed in order of the primary system and not in order of importance.

Prove viability of capital spare printed circuit boards already in the Warehouse.

We have found brand new capital spares in the Warehouse that will not operate when installed in the equipment. UPS cabinets in system APA have been a problem and other systems could have the same potential. Often there is only a single board in stock and must be known to be good. Develop a plan to exchange warehouse spares with installed boards during outage windows.

Purchase one complete spare switchboard for a PC Distribution Panelboard, Essential AC Distribution Panelboard, and a DC Unit Battery Distribution Panelboard.

These panelboards are fusible disconnect style manufactured by ITE and are each a different size. They are obsolete and no longer supported. A fault on the bus could destroy an entire panelboard. We only stock a very few individual fusible units. Loss of any of these system panelboards would cause loss of selected critical equipment.

Purchase spare tray cable of common types to make emergency repairs.

Fires and other sources of damage could be devastating in the critical generation areas where cable is exposed in cable trays. We need to stock common power, instrument, and control cable types along with a selection of high voltage cable. Cable is not as readily stocked in vendor inventories as it once was. We have tight cable specifications at IGS, requiring flame retardant jacketing and other features, which makes cable suitable for us less main stream.

Purchase complete bus duct assemblies for SUS xA11 and xB11 for both units.

Failure of this bus duct has already caused a Cooling Tower reduction in the number of fans available for service for a period of three months. Fortunately, it was in the winter of 2005-2006 and did not cause a loss of generation, but could cause a derate if this failure were to occur in the summer months.

Purchase spare Cooling Tower SUS Transformer.

A single Cooling Tower SUS is not capable of running all 24 Cooling Tower Fans when there is only one SUS in service and the tie breaker closed. If an outdoor transformer were to fail, we would be in a derate situation for several weeks while a replacement transformer was procured. This purchase is in the current Capital Budget.

Purchase spare Iso-Phase Bus Duct jumper section complete with braids and shunts.

If a catastrophic event occurred at one of the breaker poles, we would need a way to continue to operate while replacements parts were ordered. We have some spare parts to a breaker pole but not a complete pole with the housings. An iso-phase bus duct section would be inserted where the Generator Breaker pole was removed. The spare section would include braids and shunts for a complete connection end-to-end to existing iso-phase bus on either side of the Generator Breaker. Syncing of the generator along with protection would be relocated to ICS control.

Purchase a spare GSU neutral grounding resistor assembly.

There is no blast wall between the GSU transformer and the grounding resistor. In the case of a catastrophic explosion of the GSU, damage to this adjacent structure would most likely render the equipment inoperable. We have a spare GSU but not the related grounding resistor assembly.

Balance of Plant Systems

Introduction and Description of Analyzed Systems

The operation of an efficient coal fired power plant requires careful observation and maintenance of many integrated auxiliary systems. These auxiliary systems will be subjected to changing operating regimes, fuels, and environmental demands during the life of the facility. The maintenance of these auxiliary systems is also often subordinate in importance to the boiler, turbine, and generator.

The intent of this section is to review what auxiliary systems are critical to the availability of the facility and to identify improvements that can be made in both operation and maintenance to insure their long term viability.

For this analysis, Balance-of-Plant (BOP) Systems consists of all critical systems (Criticality 1 or 2) other than the Turbine-Generator, Steam Generator and for this analysis, Electrical Systems. The Converter Station is also not included. Even though the coal yard was not considered critical because of inherent redundancy, a brief review of that equipment was also completed.

Electrical systems would generally be considered a BOP system by most definitions but, concerns over recent problems with electrical systems make it prudent to analyze the electrical equipment as a separate system to give it more attention.

The following System Codes were analyzed with the BOP Systems:

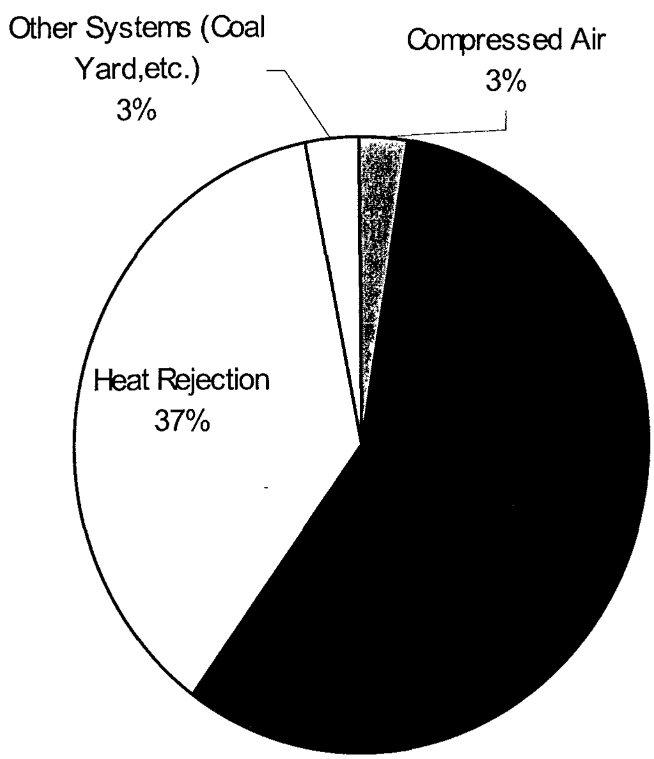
Plant System	System Code
Compressed Air	CAB
Induced Draft	CCE
Equipment Cooling	ECB
Feedwater	FWA
Heat Rejection	HRA, HRC & HRD
All Other Systems	CH, CC, etc.

Losses of Availability

Historically, the BOP Systems have attributed to around 7 percent of the total losses of availability for the station. Combine the BOP statistic of 7 percent with the 8 percent of the electrical systems to get 15 percent and you can compare the IGS experience with data reported by EPRI in a 2002 report(1). EPRI reported that BOP systems contributed to13.8 percent of all losses of availability which is very similar to IGS. IGS is also similar to NERC-GADS with the majority of BOP outages being caused by the feedwater system and the heat rejection system.

Balance of Plant Systems

(Percentage of Total Equivalent Availability Losses by Subsystem)



Some of the key statistics gathered from an analysis of the IGS historical data:

	Unit 1	Unit 2	Station
Number of Events Caused by Balance of Plant Systems	125	86	211
Percentage of All Events Caused by Balance of Plant Systems	25.3%	19.9%	22.8%
Number of Forced Outages Caused by Balance of Plant Systems	35	22	57
Percentage of All Forced Outages Caused by Balance of Plant Systems	22.3%	15.7%	19.2%
Equivalent Hours of Lost Generation Caused by Balance of Plant Systems	243.1	249.9	493
Percentage of All Equivalent Hours of Lost Generation Caused by Balance of Plant Systems	6.6%	6.6%	6.6%

It is interesting to note that while the BOP only causes less than 7 percent of the total lost availability, it does cause more than 20 percent of the total events and almost 20 percent of the forced outages. This means the forced outages from BOP equipment are generally shorter in time but, as frequent or more frequent than the boiler or turbine-generator.

The main culprit on forced outages (unit trips) is the Boiler Feed Pumps (BFP) with 29 forced outages on Unit 1 and 15 on Unit 2 being caused by either the pump or the turbine. The unit trips on drum level excursions caused by the upset. The Boiler Feed Pumps also cause a large number of derates because neither unit can operate at full load with one or the other feed pump out-of-service.

The mechanical aspects of the boiler feed pumps and turbines have actually been very reliable with only a few incidents caused by mechanical failure. Most of the trips or incidents with the boiler feed pumps are associated with the controls or monitoring systems. Correcting the problems with the Boiler Feed Pump and Boiler Feed Pump Turbines (BFPT) would reduce the majority of generation losses and trips associated with Balance of Plant equipment and could significantly reduce the total number of plant forced outages.

Predictive Maintenance

Since the BOP systems incorporate such a large variety of equipment, it is difficult to discuss what predictive maintenance we are currently performing in this area without a general presentation on all available predictive maintenance technologies. Suffice it to say that we utilize vibration monitoring, lube oil condition monitoring, performance monitoring, and any other available technique to monitor and track the condition of this equipment.

The task force meetings came up with the following recommendations for improvements in the predictive maintenance of this equipment:

Testing of Critical Auxiliary Heat Exchangers

The Closed Cycle Cooling Water System provides cooling to many critical pieces of equipment such as Air Compressors, EHC, Stator Cooling, BFPT Lube Oil, FD Fan Lube Oil and ID Fan Lube Oil. We have done little, if any, condition monitoring for these heat exchangers since they were originally placed into service. The failure of one of these heat exchangers could release large amounts of water into critical systems causing extensive damage and downtime.

Even though the Closed Cycle Cooling Water is treated to reduce corrosion potential and the heat exchangers were designed with corrosion resistant materials, we recommend that a program be developed to systematically test these heat exchangers to insure there is no corrosion or erosion occurring.

Compressed Air Usage Audit

Over the 20 years of operation, we have steadily been losing redundancy in the compressed air system because of increased demand. Much of that demand is the result of leakage or inefficient use of compressed air (air horns instead of fans). We recommend that a compressed air usage audit be performed to identify and quantify the locations of air usage and waste and then a program be developed to reduce usage down to insure redundancy is maintained.

Maintenance Improvements

Maintenance of the BOP systems is a combination of Predictive (condition based), Preventive (time based), and Corrective (as-needed) Maintenance. The type used for each piece of equipment is dependent on the value, criticality, and accessability of the equipment or system. The task force recommends the following to improve the maintenance of the BOP Systems:

PM for Air Compressor Back-up Nitrogen Control Air System

The compressors require control air for start-up and operation. A back-up nitrogen bottle system was installed with original construction to provide start-up control air in the event of a black-trip or loss of all control air. This system has not been periodically tested or maintained, because it has never been needed. We recommend that a PM Work Order be established that will periodically trigger the technicians to test and maintain this equipment in the event it is ever needed.

Air Compressor Control Drawings

The control drawings for the air compressors do not reflect all of the changes that have been implemented to the system over the last 20 years. The drawings should be reviewed and updated as needed to make sure the technicians have the information they need to troubleshoot and repair this critical equipment.

Recommended Capital Improvements

The projects below represent some of the major recommendations from the task force meetings. See the list of recommendations for the full list.

Boiler Feed Pump Controls Upgrade

It is easy to see that the main improvement that would increase the reliability of the BOP systems would be to improve the BFP and BFPT controls. We are currently implementing a capital project to upgrade the existing 20 year old GE-MDT20 analog controls with digital controls and a state-of-the-art governor system.

Failures of the BFPT components (seals, labyrinths, blades, rotor, etc.) are typically resultant of actual over-speed conditions and lube oil failure. According to the OEM, the new system will feature a significantly more reliable (99.999 percent reliability) electronic over-speed trip device and redundant lube oil pressure supervisory system. Additionally, both of these systems are on-line testable without having the need to trip the turbine.

Currently, the OEM requires the existing over-speed "governor" to be tested prior to any start-up. This process requires the machine to run up to 10 percent over-speed to be able to calibrate and/or verify the over-speed trip set point. This practice is time consuming and creates additional stress on the components and auxiliaries. The new digital over-speed trip device is reliable, consistent and is not subjected to mechanical wear. It allows online testing without the machine actual over-speed.

We have contracted with GE for the new digital systems. Unit 1 will be completed in April, 2007 and Unit 2 in April, 2008.

Upgrade BFP Recirculation Valve Controls

The controls for the BFP recirculation valves are independent of the pump and turbine controls. We have had four previous forced outages on both units from the recirculation valves coming open. When the recirculation valves open it disrupts the flow of feedwater to the drum and the unit trips on low drum level. The recirculation valves are meant to only operate during start-ups or in the event of a unit trip or upset.

We recommend replacement of the original pneumatic controls for these valves with more reliable digital controls. The digital controls should improve the reliability and response.

Restore Structural Integrity of Circulating Water Make-up Supply Line

We know from previous experience that the 30-inch Prestressed Concrete Cylinder Pipe (PCCP) that supplies make-up water from Water Treatment to the Cooling Towers is probably failing from external corrosion of the reinforcing wires. We recommend that a project be implemented in the near future to either repair or replace this line.

Split Air Compressor Control Power

The air compressor control power is currently split so that the loss of one power source will only trip, at the most, two of the three operating air compressors. However; both units cannot operate with only one air compressor, even if the service air is isolated from the control air. We recommend that the control power be split one more level such that only one air compressor will trip with the loss of individual power source.

Split ID Fan Exciter Power Supply

The ID Fan Exciter Power Supply is currently set-up so that it is split between individual cubicles at the Motor Control Center (MCC) level but, that MCC is fed from one Secondary Unit Substation (SUS). This means that the loss of that one SUS will cause all four ID fans to trip, and also the unit to trip. We recommend that the power supply be split so that the loss of one SUS will only result in the loss of two ID fans. This would save a unit trip and only result in a derate until the other two fans could be restored.

Additional Spare Parts

The spare parts below represent some of the major recommendations from the task force meetings. See the list of recommendations for the full list.

Spare Air Compressor Coupling

We currently have a spare air compressor motor, but no spare motor to compressor coupling. We recommend investigating the cost and economic benefit of purchasing a spare coupling to have available in the event of a coupling failure.

Closed Cycle Cooling Water Pump

The Closed Cycle Cooling Water Pumps have been rebuilt several times and some the tolerances and fits are becoming difficult to maintain. We recommend an analysis of the possible purchase of a spare Closed Cycle Cooling Water Pump. Having a spare pump will allow the rebuilds to take place in the shop and will allow more time for restoration and inspection. The spare will also provide a "Ready Spare" in the event of a failure.

Boiler Feed Pump Turbine Couplings

We do not maintain a spare turbine to pump coupling even though we have a spare pump volute. A catastrophic failure could result in significant downtime waiting for the coupling even though the volute is ready to be installed. An analysis should be completed of the possible purchase of a spare coupling.

Spare ID Fan Transformers

The uprate to 950 MWG requires that all four ID fans be available for full load operation. This means that the loss of an ID Fan will result in a derate. Several of the transformers for the ID fan drives have failed previously and the lead time for a replacement is six months or more. We recommend that a review be done of the risk and benefits of purchasing a spare transformer.

Spare Magnetic Coupling for Conveyors 18A and 18B

We have spare motors, gearboxes and pulleys for most coal conveyors. Since we have changed to magnetic couplings in some applications, we have not maintained spares like we previously had with the fluid couplings. Even though the unit could continue to operate with only one conveyor path, the delivery of a new magnetic coupling would take over three months. We recommend purchasing a spare to insure that the coal supply to the unit will not be jeopardized.

ICS Controls (COX)

Description of Systems

The ICS Controls Systems consist of all control systems that control the Rectifier process, the *Station protections, Filter protections and Raw and Fine Water Controls. All of these systems* are fully redundant and spares are provided for each of the circuit boards and interpose relays. Because of this redundancy, the control systems have a Criticality ranking of 3.

The following System Codes were analyzed with the Control Systems.

Control System	System Code
Bipole Controls	COX-B
Pole 1 Controls	COX-1
Pole 2 Controls	COX-1
Station Controls	COX-ST
Filter Controls	COX-STA

Recommended Spare Parts

- One (1) complete set of Circuit Boards, Terminal Boards, and Processor Boards that can be used to replace any type of board required for the Bipole Controls, Pole 1 Controls, Pole 2 Controls, Station Controls and Protections, and Filter Controls and Protections.

- One (1) complete set of Control/Protection Transducers and Meters to match any type used in the control systems as stated above.

- One (1) complete set of Control/Protection Relays to match each type of relay required as above.

- One (1) Complete set of Fiber Optic terminals for the Optical Current Transducer modules.

Note: The Criticality ranking of 3 is because of the full redundancy. These Systems are critical for the operation of the Converter Station. Therefore, one (1) spare type of each set of Circuit Boards, Transducers, Meters, and Relays maintains the redundancy.

ICS Pole 1 Equipment (P1DC)

Description of Pole 1 DC System

The Pole 1 DC System consists of all the equipment necessary to convert alternating current to direct current and the bus-work and equipment necessary to provide a reliable, reconfigurable connection path for bipolar/monopolar and metallic/ground operation between the HVDC valve halls and each end of the transmission line at Intermountain and Adelanto. The DC Pole 1 equipment at each station can be divided into six groups, consistent with their functionality. These groups are (1) switching equipment, including breakers and disconnect switches, (2) protective devices to limit transient currents and voltage surges, (3) filters to reduce harmonic current and carrier and radio interference, (4) converter transformers and thyristor valve modules for AC to DC conversion, (5) measuring transducers for current and voltage levels, and (6) heat exchangers, motors, and pumps to remove excess heat from the thyristor valves.

The following System Codes were analyzed with the Pole 1 DC systems.

Pole 1 Systems	System Code
Pole 1 High Voltage Bus	P1DC-H
Pole 1 Neutral Bus	P1DC-N
Pole 1 DC Filters	P1DF
Pole 1 Valve Hall	P1VH
Pole 1 AC Yard	P1AC
Pole 1 Fine Water Cooling	P1FW
Pole 1 Raw Water Cooling	P1RW

Although this equipment is redundant or reconfigurable, loss of one or more components may cause partial load loss and is therefore given a Criticality 2 ranking.

Recommended Spare Parts

(High Voltage Bus, P1DC-H)

- One (1) complete Disconnect Switch, including insulator stacks and grounding switch for 1H/2H.
- One (1) complete set of components for CCP1.H.
- One (1) set of spare components for Arrester, DCT, Reactor, Line Trap, and Voltage Divider.
- One (1) set of spare Connectors for bus-work and 2 sets of spares for each type of line connection.

(Neutral Bus, P1DC-N)

- One (1) set of spare components for Arrester, DCT, Line Trap, Voltage Divider, Capacitor Stack.

- One (1) complete spare Circuit Breaker for use at 1N, 2N, 1E, or 2M.
- One (1) complete spare Neutral Disconnect Switch.
- One (1) spare Insulator of each type used on Neutral Bus.

(DC Filters, P1DF)

- Recommend taking Filter Bank 2 or 3 Out-Of-Service and keeping it as a cold spare which can be tuned as either a 12^{th} or 24^{th} Harmonic Filter.

(Valve Hall, P1VH)

- One (1) new Valve Test Unit
- Maintain discrete components at 5 percent spares level for Thyristor Valve.
- One (1) complete spare set of PEX tubes and connectors.
- One (1) complete Thyristor Valve Module ready for service.

(AC Yard, P1AC)

- One (1) complete spare Converter Transformer
- One (1) complete set of spare Contactors for 1 Cooler Group.
- One (1) spare Bucholz Relay
- One (1) set of spare Bladders for each type needed for conservator tanks kept under N2.
- One (1) set of spare Connectors for bus-work and 2 sets of spares for each type of line connection.
- One (1) set of spare CVTs and CTs for each type needed.
- Maintain 5 percent spares for capacitors and reactors needed in PLC yards.

(Fine Water, P1FW)

- One (1) set of spare fittings for heat exchangers, pipes, pumps, and valves.
- One (1) complete set of spare gaskets for a heat exchanger.
- One (1) set of spare valve handles for each type needed in fine water cooling system.

(Raw Water, P1RW)

- One (1) spare pump, motor, and valve for each type needed in raw water cooling system.

Recommended Additional Capital, Predictive or Maintenance Improvements

- Perform Furans testing on all oil-impregnated-paper insulated equipment.
- Install transformer on-line monitoring for Doble Insulator Testing and Dissolved Gas Analysis.
- Modify cooling equipment crane/hoist rails to position directly overhead the heavy equipment.
- Install bypass piping and small ball valve on fine water filter tank.
- Replace existing cooling towers due to end-of-service-life and obsolescence.

ICS Pole 2 Equipment (P2DC)

Description of Pole 2 DC System

The Pole 2 DC System consists of all the equipment necessary to convert alternating current to direct current and the bus-work and equipment necessary to provide a reliable, reconfigurable connection path for bipolar/monopolar and metallic/ground operation between the HVDC valve halls and each end of the transmission line at Intermountain and Adelanto. The DC Pole 2 equipment at each station can be divided into six groups, consistent with their functionality. These groups are (1) switching equipment, including breakers and disconnect switches, (2) protective devices to limit transient currents and voltage surges, (3) filters to reduce harmonic current and carrier and radio interference, (4) converter transformers and thyristor valve modules for AC to DC conversion, (5) measuring transducers for current and voltage levels, and (6) heat exchangers, motors, and pumps to remove excess heat from the thyristor valves.

The following System Codes were analyzed with the Pole 2 DC systems.

Pole 2 Systems	**System Code**
Pole 2 High Voltage Bus	P2DC-H
Pole 2 Neutral Bus	P2DC-N
Pole 2 DC Filters	P2DF
Pole 2 Valve Hall	P2VH
Pole 2 AC Yard	P2AC
Pole 2 Fine Water Cooling	P2FW
Pole 2 Raw Water Cooling	P2RW

Although this equipment is redundant or reconfigurable, loss of one or more components may cause partial load loss and is therefore given a Criticality 2 ranking.

Recommended Spare Parts

(High Voltage Bus, P2DC-H)

- One (1) complete Disconnect Switch, including insulator stacks and grounding switch for 1H/2H.
- One (1) complete set of components for CCP1.H.
- One (1) set of spare components for Arrester, DCT, Reactor, Line Trap, and Voltage Divider.
- One (1) set of spare Connectors for bus-work and 2 sets of spares for each type of line connection.

(Neutral Bus, P2DC-N)

- One (1) set of spare components for Arrester, DCT, Line Trap, Voltage Divider, Capacitor Stack.

- One (1) complete spare Circuit Breaker for use at 1N, 2N, 1E, or 2M.
- One (1) complete spare Neutral Disconnect Switch.
- One (1) spare Insulator of each type used on Neutral Bus.

(DC Filters, P2DF)

- Recommend taking Filter Bank 2 or 3 Out-Of-Service and keeping it as a cold spare which can be tuned as either a 12^{th} or 24^{th} Harmonic Filter.

(Valve Hall, P2VH)

- One (1) new Valve Test Unit
- Maintain discrete components at 5 percent spares level for Thyristor Valve.
- One (1) complete spare set of PEX tubes and connectors.
- One (1) complete Thyristor Valve Module ready for service.

(AC Yard, P2AC)

- One (1) complete spare Converter Transformer
- One (1) complete set of spare Contactors for one (1) Cooler Group.
- One (1) spare Bucholz Relay
- One (1) set of spare Bladders for each type needed for conservator tanks kept under N2.
- One (1) set of spare Connectors for bus-work and 2 sets of spares for each type of line connection.
- One (1) set of spare CVTs and CTs for each type needed.
- Maintain 5 percent spares for capacitors and reactors needed in PLC yards.

(Fine Water, P2FW)

- One (1) set of spare fittings for heat exchangers, pipes, pumps, and valves.
- One (1) complete set of spare gaskets for a heat exchanger.
- One (1) set of spare valve handles for each type needed in fine water cooling system.

(Raw Water, P2RW)

- One (1) spare pump, motor, and valve for each type needed in raw water cooling system.

Recommended Additional Capital, Predictive or Maintenance Improvements

- Perform Furans testing on all oil-impregnated-paper insulated equipment.
- Install transformer on-line monitoring for Doble Insulator Testing and Dissolved Gas Analysis.
- Modify cooling equipment crane/hoist rails to position directly overhead the heavy equipment.
- Install bypass piping and small ball valve on fine water filter tank.
- Replace existing cooling towers due to end-of-service-life and obsolescence.

Station AC Switchyard Equipment (SWE)

Description of AC Switchyard Equipment

The Intermountain Station AC Switchyard serves as a switching point to the AC system in Utah via two 345-kV AC transmission lines to the Mona Substation, to the AC system in Nevada via one 230-kV AC transmission line to the Gonder Substation, to the two AC generators at Intermountain, to the two HVDC converters at Intermountain, and to the three AC filter banks also located adjacent to the AC Switchyard at Intermountain. Complete isolation for these connections is made by way of circuit breakers, disconnects, and grounding switches.

The following System Codes were analyzed with the AC Switchyard Equipment.

Switchyard Systems	System Code
345 kV Bus 1 and Bus 2	SWE-0
B Rack 46 kV	SWE-1
Bank M Gonder	SWE-2
Position E5 - Gonder	SWE-5
Position E6 - Filter Bank 3	SWE-6
Position E8 - Filter Bank 2 and Pole 2	SWE-8
Position E9 - Aux Bank L and Unit 2	SWE-9
Position E10 - Aux Bank K and Unit 1	SWE-10
Position E11 - Filter Bank 1 and Pole 1	SWE-11
Position E12 - Mona 1	SWE-12
Position E13 - Mona 2	SWE-13

Except for Bank M, this equipment is redundant through a breaker-and-a-half scheme. Loss of any single piece of equipment for all positions except Bank M would result in a Criticality 3, and loss of equipment for Bank M (Gonder) would be a Criticality 2 factor.

Recommended Spare Parts

- One (1) set of spare conductor connectors for bus-work and two (2) sets of spares for each type of line connection.
- One (1) complete 3-phase spare of the Westinghouse 345 kV breaker
- One (1) complete phase spare of the Mitsubishi 345 kV breaker
- One (1) complete spare 345 kV disconnect
- One (1) complete spare 46 kV breaker
- One (1) complete spare 46 kV disconnect
- One (1) complete set of spare 46 kV fuses for each type of fuse.
- One (1) complete set of spare CVTs and CTs for 345 kV, 230 kV, and 46 kV busses.

- One (1) set of spare 46 kV potheads.
- One (1) set of spare cable splice kits for all cable sizes.

Station AC Filters (STA)

Description of AC Filter Equipment

The Intermountain Station AC Filter Banks absorb the odd harmonic currents generated by the converters. They also contribute to balancing the reactive power consumption of the converters. At low DC power levels, the needed filters could cause overcompensation. In order to prevent this, the filter banks are complemented with a shunt reactor in each filter bank. The filter banks also help maintain AC system stability.

The following System Codes were analyzed with the AC Filter Bank Equipment.

Filter Systems	System Code
AC Filter Bank 1	STA 1
AC Filter Bank 2	STA 2
AC Filter Bank 3	STA 3

As originally designed, two AC filter banks provided the necessary harmonic current filtering and the reactive power required by the HVDC converter bipole. The third AC filter bank was a redundant backup to allow maintenance for any one filter bank when required.

Pursuant to the uprate of the Intermountain generation units, all three AC filter banks are now required to be in service to maintain proper switchyard voltage and to balance the reactive power consumption. Therefore, losing any AC filter bank imposes a Criticality 2 factor for availability.

Recommended Spare Parts

- Five (5) percent spare capacitors for each capacitance value in the sub-bank filters.
- Three (3) spare reactors for the 11/13 sub-bank filter.
- Three (3) spare reactors for the 3/5/7 sub-bank filter.
- One (1) spare CT for each type in the Filter Bank.

Recommended Additional Capital, Predictive or Maintenance Improvements

- Install monitoring equipment to measure on-line filter performance.
- Purchase a capacitor bridge test unit to check capacitance of each sub-bank filter.

ICS Auxiliary Power (APX)

Description of ICS Auxiliary Power

The auxiliary power at ICS consists of four independent supply transformers, each of which can supply the entire auxiliary power load for the converter station. Two are generally in service, each feeding a different supply bus. The supply bus then feeds transformers that supply the 480 volt busses. Each piece of equipment is fed from these dual busses. The loss of power at any point in the system will thus result in a transfer to an alternate bus or source.

The AC Relay House has 3 independent supply transformers, each of which can supply the entire auxiliary power load of the relay house. Two are generally in service, each feeding a different supply bus. The supply bus then feeds transformers that supply the 480 volt busses. Each piece of equipment is fed from these dual busses. The loss of power at any point in the system will thus result in a transfer to an alternate bus or source.

All equipment is redundant, and the loss of any part of the system will not result in load loss, and is therefore given a Criticality of 3. This system is a vital component for the running of the Intermountain Converter Station and Intermountain Relay House and AC Switchyard.

Battery systems for the Converter Station consist of two independent 125 VDC battery systems with redundant chargers, two 48 VDC battery systems with redundant chargers, and two 24 VDC battery systems with redundant chargers. These systems are Criticality 3 because of redundancy.

Battery systems for the AC Relay House consist of two independent 250 VDC battery systems with redundant chargers, and two 48 VDC battery systems with redundant chargers. These systems are also Criticality 3 because of redundancy.

Recommended Spare Parts

- One (1) complete set of spare circuit boards and other discrete components required in each separate type of battery chargers.

Recommended Additional Capital, Predictive or Maintenance Improvements

- Replace all batteries and chargers because of End-of-Life and obsolescence.

Outline of Plan for Reliability Assurance Project

The project will be broken down into five different steps:

1. **System Criticality Assessment**
   a. Objective: Evaluate and identify the plant systems that by design, have the highest potential for negatively affecting availability of IGS, ICS and STS.
   b. Tasks:
      i. Using the original Plant System Codes, review each plant system and sub-system and identify system which impact plant availability.
      ii. Assign a criticality index number to each system and sub-system based on the potential for negatively impacting plant availability considering such things as redundancy of equipment and past history of availability losses from the system.
   c. Result: A spreadsheet of all plant systems and sub-systems ranked by the potential to negatively affect plant availability with documentation of rationale used for ratings. The remaining steps of this project will only be completed for the systems with significant potential to reduce availability. This will focus the efforts to the areas with the highest potential for improvement.

2. **Assessment of Condition Monitoring**
   a. Objective: Evaluate the available methods for monitoring the condition of the systems and equipment both on and off-line.
   b. Tasks:
      i. Review each piece of equipment within the sub-system to determine what methods of condition monitoring are available for that equipment.
      ii. Review what condition monitoring is currently being done and evaluate possible changes to our current programs.
   c. Results: Recommendations for changes to the plant condition monitoring programs. A report by system code of possible condition monitoring, current monitoring programs and rationale for changes to our current program.

3. **Assessment of Maintenance Plans and Methods**
   a. Objective: Evaluate the current and available methods, plans and programs for maintaining the systems, sub-systems and individual pieces of equipment.
   b. Tasks:
      i. Review the current and available maintenance methods, practices and procedures for each system.
      ii. Review possible changes to the maintenance plans, evaluate the changes both technically and economically.
   c. Results: Recommendations for changes to the existing maintenance program for each system. A report by system code of the existing maintenance procedures, available methods and rationale for changes.

4. **Critical Spare Parts Evaluation**

a. Objective: Evaluate what critical parts are necessary for each system and piece of equipment.

b. Tasks:
   i. Review what parts are necessary to prevent significant reductions in availability in the event of a failure
   ii. Inventory which of those parts are actually available (physically verify) and identify condition of parts.
   iii. Economically evaluate the possible purchase of additional parts

c. Results: Recommended list of additional spare parts that should be purchased and a report on the status of spare parts in the warehouse.

5. **<u>Plan for Future Renewals and Replacements</u>**

a. Objective: Plan for future renewals and replacements by identifying them as far ahead as possible.

b. Tasks:
   i. Review each system and forecast remaining life of equipment.
   ii. Economically evaluate each possible project and determine an estimated year for completion and project cost.

c. Results: Recommended list of renewals and replacements including smaller projects not shown on previous 10-year budgets.

<u>Outline of Report on Availability Improvement Project</u>

<u>Executive Summary</u>

Description of Project
List of Additional Capital, Predictive or Maintenance Improvements
List of Recommended Additional Spare Parts

<u>Introduction</u>

Purpose of Project
Historical Losses of Availability
Rationale for Critical Systems
List of Critical Systems

<u>Steam Generator</u>

Description of System
Breakdown on Losses of Availability
Available and Current Methods of Predictive Maintenance
Maintenance Methods and Philosophies.
Recommended Additional Capital, Predictive or Maintenance Improvements
Recommended Additional Spare Parts

<u>Turbine Generator</u>

Description of System
Breakdown on Losses of Availability
Available and Current Methods of Predictive Maintenance
Maintenance Methods and Philosophies.
Recommended Additional Capital, Predictive or Maintenance Improvements
Recommended Additional Spare Parts

<u>Electrical Systems</u>

Description of System
Breakdown on Losses of Availability
Available and Current Methods of Predictive Maintenance
Maintenance Methods and Philosophies.
Recommended Additional Capital, Predictive or Maintenance Improvements
Recommended Additional Spare Parts

Balance of Plant

Description of System
Breakdown on Losses of Availability
Available and Current Methods of Predictive Maintenance
Maintenance Methods and Philosophies.
Recommended Additional Capital, Predictive or Maintenance Improvements
Recommended Additional Spare Parts

Converter Station

Description of System
Breakdown on Losses of Availability
Available and Current Methods of Predictive Maintenance
Maintenance Methods and Philosophies.
Recommended Additional Capital, Predictive or Maintenance Improvements
Recommended Additional Spare Parts

Appendix:

List of Recommendations

Complete of plant System with Criticality Codes

Explanation of FERC Types and Events

List of Availability Incidents by System

10-Year Capital Budget

Priority Codes for Availability Improvement Project Suggestions

Priority 1 - Highest priority, it will receive consideration for immediate implementation or at next available budget cycle.

A. Suggestion is for Criticality Factor 1 System and implementation of the suggestion could have an immediate impact on system availability.

B. Suggestion is for Criticality Factor 1 or 2 System and even though implementation may not have immediate impact on availability, it so easy or inexpensive to implement that it should be done as soon as possible.

Priority 2 - Medium priority, it will be considered for implementation in the next or future budget cycles as funds are available.

A. Suggestion is for Criticality Factor 2 System and implementation of the suggestion could have an immediate impact on system availability.

B. Suggestion is for Criticality Factor 3 or 4 System and even though implementation may not have immediate impact on availability, it so easy or inexpensive to implement that it should be completed as funds and time are available.

C. Suggestion is for Criticality Factor 1 System but, implementation would have only a moderate impact on system availability.

D. Suggestion is for Criticality Factor 3 or 4 System but, the impact on system availability is high.

Priority 3 - Low priority, suggestion will be retained on the tracking spreadsheet for future evaluation but, will not be considered for implementation at this time.

A. Suggestion is for Criticality Factor 3 or 4 System and implementation of the suggestion could have a moderate impact on system availability.

B. Suggestion is for Criticality Factor 1 or 2 System but implementation would have only a minor impact on availability or would have a moderate or high impact but, the cost of implementation is so high that it is difficult to justify.

Priority 4- No priority, suggestion will be eliminated from the active tracking spreadsheet with no further action required. Suggestion will be retained in an inactive file for future reference.

A. Suggestion has been evaluated and cannot be economically justified.

B. Suggestion has no technical merit.

Internal Business Process
Objective: Minimize Impact of the Aging Plant
Initiative: Complete Availability Assurance Project with Third Party Participants

Status: The plant Availability Assurance Project was a team approach to identifying and prioritizing suggestions for improving and maintaining plant availability. This process has identified 159 suggestions, 123 for the Generating Station and 36 for the Converter Station. Those 159 suggestions were then prioritized according to the following:

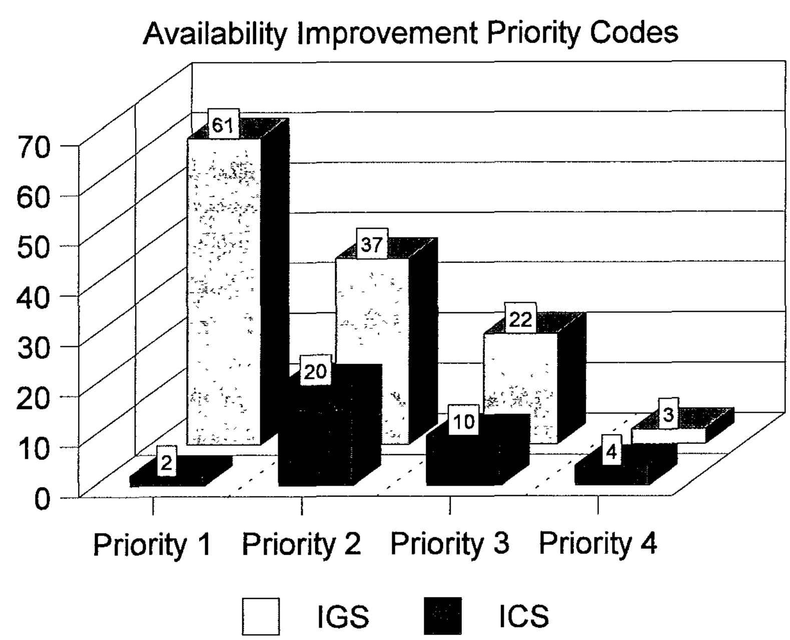
Priority 1 - Highest priority; it will receive consideration for immediate implementation or at next available budget cycle.

Priority 2 - Medium priority; it will be considered for implementation in the next or future budget cycles as funds are available.

Priority 3 - Low priority; suggestion will be retained on the tracking spreadsheet for future evaluation, but will not be considered for implementation at this time.

Priority 4- No priority; suggestion will be eliminated from the active tracking spreadsheet with no further action required. Suggestion will be retained in an inactive file for future reference.

The results were:



IP12_000338

- Of the 61 Priority 1 suggestions for the Generating Station
  - 27 have been completed.
  - 17 are in progress or on a future budget.
  - 8 are still open pending further analysis.
  - 9 have been evaluated but cancelled because they were not technically feasible or not economically justified.

- Of the 2 Priority 1 suggestions for the Converter Station
  - 1 has been completed.
  - 1 is in progress.

- Of the 37 Priority 2 suggestions for the Generating Station
  - 7 have been completed.
  - 11 are in progress or on a future budget.
  - 13 are still open pending further analysis.
  - 6 have been evaluated but cancelled because they were not technically feasible or not economically justified.

- Of the 20 Priority 2 suggestions for the Converter Station
  - 7 have been completed.
  - 6 are in progress or on a future budget.
  - 7 are still open pending further analysis.

The Priority 3 and Priority 4 recommendations are not being evaluated at this time.

Condition Monitoring: In the area of condition monitoring, the following suggestions have been or are in the process of being implemented to improve our existing programs:

- Perform an audit of the compressed air system to document the amount of leaks
- Perform a tube thickness survey of the boiler slope tubes to determine remaining life.
- Develop a program to identify areas in boiler piping that may be experiencing flow accelerated corrosion
- Add viewing windows for on-line infrared inspection of electrical connections

Maintenance Plans and Methods: The teams also looked at methods to improve maintenance plans and methods. Some examples of the suggestions are:

- Fully dress and test the spare transformers to make sure they are suitable for service if needed.
- Use chill rings to reduce the repair time for boiler tube leaks
- Investigate options for improving contractor performance and QC for safety valve overhauls

- Increase frequency of FD Fan Rotor overhauls. Operating too close to failure.

Critical Spare Parts: One of the areas of focus was spare parts. Many suggestions were given for additional spare parts, some of the more critical spare parts were:

- Speed change switches for FD and PA Fans
- Hydraulic pumps for FD Fans
- Spare Turbine Main Seal Oil Pump Motor
- Spare Stator Cooling Water Pump Motor

Plan for Future Renewals and Replacements: We have maintained a list of possible future capital projects for years but, this group identified some additional items:

- Replace generator hydrogen monitoring system
- Replace essential service inverters on one unit and use the parts to maintain the other unit.
- Move-up the replacement of the generator breakers, parts are very difficult to obtain.

Economics of IP Turbine Densepack Modifications

We have evaluated the potential economic benefits for installing IP Turbine Dense Pack modifications on Unit 1 and Unit 2 similar to what was done with the HP turbines and have determined that this modification cannot be economically justified.

Since we cannot increase unit output like we did with the HP Turbine Dense Pack, an IP Turbine Dense Pack Modification would have to be justified on just heat rate improvement alone. Installing IP Turbine Dense Packs would improve unit heat rate somewhere between 0.2% to 0.4% depending on which manufacturer's number are used. This would equate to an average heat rate improvement of 29 BTU/KWH. It is estimated that installing IP Turbine Dense Packs would cost between $13 to $14 million for both units.

From the perspective of greenhouse gas emissions, this project has the potential to reduce CO2 emissions by 41,600 tons/year.

The annual heat rate savings of 29 BTU/KWH is estimated to be worth about $665,000 in fuel costs which is not enough to result in a positive pay back. If a carbon emissions tax is imposed, a positive pay back could be achieved and this project might become economically viable.

Availability Improvement Project
List of Recommendations

Number	Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments
APA-2	1	C	APA	120 Volt Power Supply	Maintenance	Focus existing PM Review program conducted by Gary Judkins to focus next on all electrical systems	Gary-J	0	Complete
APC-2	1	C	APC	480 Volt Power Supply	Spare Part	Review outdoor bus duct assemblies for Cooling Tower SUSs. Purchase spare bus duct assemblies for both SUS A11 and B11	Kevin-M	0	We have determined that loss of one bus duct assembly would only result in derate and could be repaired temporarily with cables
APC-3	1	C	APC	480 Volt Power Supply	Spare Part	Purchase spare Cooling Tower SUS outdoor transformer	Nathan-C	125,000	Purchased and received
APH-1	1	C	APH	DC Power Supply	Capital Project	Purchase and install wet cell battery continuous monitoring system for the Unit Battery 1 & 2.	Pam Bahr		Was placed on the preliminary 2008-09 capital budget but, was rejected due to lack of justification.
API-1	1	C	API	AC Essential Service	Capital Project	Purchase replacement Inverters for Unit 1. Use removed inverters as parts to support the Unit 2 inverters.	Jon-C		Complete
CAB-2	1	C	CAB	Compressed Air	Capital Project	Split vibration cabinet control power from two supplies to four supplies so that the loss of one supply will only trip one air compressor	Nathan-C	$ -	Complete
CAB-4	1	C	CAB	Compressed Air	Maintenance	Set-up PM to check-out back-up nitrogen system for compressor control air on regular basis	Gary-J		Complete
CAB-5	1	C	CAB	Compressed Air	Maintenance	Perform audit of compressed air usage, reduce system demand so two compressors can maintain unit if needed	Craig Stumph		Complete
CAB-6	1	C	CAB	Compressed Air	Maintenance	Verify control drawings and schematics for compressors, some changes not updated on drawings (Vibration System)	Nathan-C		Drawings have been updated.
CCE-1	1	O	CCE	Induced Draft	Capital Project	Split ID Fan drive exciter power supply at the SUS level to make sure that the loss of one SUS does not trip more than two fans.	Nathan Crop	$ 27,000	Work Package has been given to Maintenance, will be done on the next outage
CCE-3	1	C	CCE	Induced Draft	Spare Part	Evaluate the capital purchase of a spare Delta - Delta Transformer for the ID Fan Drives.			They were placed on the preliminary 2008-09 capital budget but, they were rejected due to lack of justification. Jon C is going to prepare a memo to staff recommending that it placed on future
CCE-5	1	I	CCE	Induced Draft	Spare Part	Evaluate the purchase of a spare Delta - Wye Transformer for the ID Fan Drives	Nathan Crop	$ 430,000	
CCE-7	1	I	CCE	Induced Draft	Spare Part	Evaluate the purchase of a spare HVAC Booster Pump. There is installed spare but, no spare in stock. All fans would be lost without cooling pump.	Bret-K	$11,000	Complete
ECB-2	1	C	ECB	Closed Cycle Cooling	Spare Part	Spare Closed Cycle Cooling Pump Motor. On the budget for this year, just needs to get specified and purchased	Pam-Bahr -DONE		Complete
FWA-1	1	C	FWA	Feedwater	Capital Project	Upgrade BFP Recirculation Valve controls from pneumatic to digital controls or purchase spare ITT Barton controller, parts are becoming difficult to obtain.	Bill Morgan	$15,000/unit	All changed to DCS control
FWA-2	1	I	FWA	Feedwater	Spare Part	Evalute the purchase of a spare BFPT coupling	Dave-S		Cannot be justified
GTA-1	1	C	GTA	Generator Bus-Duct	Capital Project	Review Generator Breaker replacement schedule and improve delivery for the first unit. Could use parts removed from one unit to serve the second unit.	Jon-C		Breaker obsoleted in 1999. Parts availability is diminishing Replacement schedule moved up to 2011 and 2012 on the 10-year plan
GTA-2	1	I	GTA	Generator Bus-Duct	Capital Project	Add viewing windows at all Iso-Phase connnection joints to improve thermography capability with unit on line	Mike Nuttall		Cannot be justified
GTA-3	1	I	GTA	Generator Bus-Duct	Capital Project	Add infrared detection monitoring system on Iso-Phase bus duct.	Mike Nuttall		Cannot be justified
GTA-4	1	C	GTA	Generator Bus-Duct	Spare Part	Purchase spare Iso-Phase bus duct jumper sections in case of breaker pole failure Includes connecting braids and shunts	Jerry Hintze		We had discussions with Delta Unibus and they do not recommend maintaining spare sections of bus duct They maintain enough material at their shop and could fabricate what we need in an emergency. No two sections are the same so it would require stocking the entire assembly
GTB-1	1	C	GTB	Generator Transformer	Capital Project	Purchase and install GSU Transformer oil continuous dissolved gas analysis monitoring system.	Pam-Bahr		Complete
GTB-3	1	C	GTB	Generator Transformer	Maintenance	Fully dress and test the spare GSU and Aux Transformers Install bushings, bushing pockets, and CTs.	Wes-B	$200,000	GE was contracted to complete this work and it has been done
GTB-4	1	C	GTB	Generator Transformer	Spare Part	Purchase spare neutral grounding resistor bank.	Wes-B		Complete, in stock.
GTB-5	1	C	GTB	Generator Transformer	Spare Part	Review warehouse spare stocking level on GSU surge arresters	Wes-B		Spare surge arrestors were found in Warehouse #1 by Kevin Miller. Computer updated so they can be found
GTB-6	1	C	GTB	Generator Transformer	Spare Part	Review spare parts stocking level on external CTs mounted on GSU high side bushings.	Wes-B	$20,000	C

Availability Improvement Project
List of Recommendations

Number	Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments
GTB-7	1	C	GTB	Generator Transformer	Spare Part	Review spare parts stocking level on complete gasket set for GSU	Wes-B		Complete, gaskets in warehouse
HRD-2	1	C	HRD	Circulating Water Make-Up	Capital Project	Insure integrity of the 30" supply line from Water Treatment to the Cooling Tower Basins.	Jerry-H	0	Testing of this small pipe would be expensive and difficult. Since we now have the bypass line, we recommend running to failure and then replace or repair
HRD-3	1	C	HRD	Circulating Water Make-Up	Spare Part	Spare Circulating Water Make-up Pump Motor	Pam Bahr	0	Decided that we do not need a spare pump. The bypass line can feed the towers if a motor fails until a new one can be located.
SGA-1	1	C	SGA	Steam Generator	Capital Project	Replace Electromatic Relief Valves and controls with up to date technology	Dean Wood	$200,000	Was placed on the 2008-09 preliminary capital budget but, was rejected due to lack of justification.
SGA-5	1	C	SGA	Steam Generator	Maintenance	Increase use of chill rings (where applicable) during repairs to aid in quick turn around time for tube leaks.	Dave Hahn	0	Complete, has been written into repair procedures.
SGA-8	1	C	SGA	Steam Generator	Maintenance	Purchase new, up-to-date boiler tube removal / prep tooling Available tools can cut out tube sections and leave the remaining tube ends bevelled for welding.	Neno Hoelzle		Complete
SGA-9	1	C	SGA	Steam Generator	Maintenance	Increase budget for Boiler and High Pressure Piping NDE during outages.	Dean Wood	$150,000	Maintenance increased the budget for scaffolding and Technical Services increased theirs for NDE.
SGA-10	1	C	SGA	Steam Generator	Maintenance	Contract a B&W representative to perform a boiler condition assessment to ensure we are covering all critical areas and to assess recent structural issues manifested by tube cracking.	Dean Wood	$22,000	Used Structural Integrity
SGA-11	1	C	SGA	Steam Generator	Maintenance	Perform as found structural analysis of high pressure piping to identify high stress points for more focused NDE.	Dean Wood		Complete
SGA-12	1	C	SGA	Steam Generator	Maintenance	Purchase more heat treating blankets to allow IPSC to perform post-weld heat treatment on smaller repairs	Neno Hoelzle		Maintenance is buying additional blankets.
SGA-13	1	C	SGA	Steam Generator	Maintenance	Investigate more contractor options for performing safety valve repair and inspection.	Kelly Cloward	0	Current contractor is the only "green tag" vendor in area. Will continue to evaluate other contractors.
SGA-14	1	C	SGA	Steam Generator	Predictive Maintenance	Perform tube-thickness survey of boiler lower-slope floor tubes to predict the remaining life of these tubes	Dean Wood	$10,000	Completed on Unit 1 during the last outage and no problems were found.
SGA-17	1	C	SGA	Steam Generator	Spare Part	Pre-manufacture and stock pre-bent boiler tubing for anticipated boiler repairs; such as nose tubing and lower-slope bend tubing or purchase tube bending machine.	Craig Stumph	0	Local shop in Utah County can bend tubes as needed during emergency Not justified to purchase bending machine
SGA-18	1	C	SGA	Steam Generator	Capital Project	Evaluate capital project to replace the electromatic relief valves or relief valve controls with newer technology to improve reliability and decrease wear on main steam relief valves	Dean Wood		Duplicate of SGA-1
SGB-1	1	C	SGB	Combustion Air Supply	Maintenance	Increase frequency of FD fan rotor rebuilds. Based on report from last tear down, we went too long	Kelly Cloward	0	rebuilds are set up on an 8-year rotation as recommended by OEM
SGB-2	1	C	SGB	Combustion Air Supply	Spare Part	Evaluate the purchase of spare speed change switches for PA and FD fans	Wes-B	0	Switches are in warehouse, were purchased with spare motor.
SGB-3	1	C	SGB	Combustion Air Supply	Spare Part	Evaluate the purchase of spare hydraulic pump for FD fans	Kelly Cloward		Spare hydraulic pump is stocked
SGB-4	1	C	SGB	Combustion Air Supply	Spare Part	Evaluate the purchase of a spare Lube oil pump for FD fans	Kelly Cloward		Spare lube oil pump is stocked
SGI-1	1	O	SGI	Soot Blowing	Maintenance	Replace thermal drain valves on sootblowing system	Gary Judkins		We have installed a float trap drain as a test but, it is not working any better than the thermal drains We are evaluating other options.
SGI-2	1	C	SGI	Soot Blowing	Maintenance	Replace controls on thermal drain valves on sootblowing system	Jerry Finlinson		Duplicate
TGA-2	1	C	TGA	Turbine	Capital Project	Upgrade pedestal monitoring system so that it can be used to assist turbine alignment accuracy. System is no longer functional.	Aaron-N	$10,000	Has been upgraded and is now working.
TGA-14	1	C	TGA	Turbine	Spare Part	Review condenser expansion joint spare part inventory	Kelly Cloward		Min/max changes have been submitted to stock one complete replacement
TGB-1	1	O	TGB	Generator	Capital Project	Review replacing the outdated generator pyrolosate core monitor system.	Nathan-C/ Jerry Finlinson	$80,000	Placed on the 2008-09 capital budget
TGB-2	1	C	TGB	Generator	Spare Part	Purchase field rewind kit and upgrade the insulation This will be for Unit 2 after Unit 1 is rewound in 2007	Jon-C ~DONE	0	Rewind kit was purchased and then used on Unit 1 for rebuild GE has indicated that they can supply a rewind quick in an emergency so no need for us to purchase and stock.

Availability Improvement Project
List of Recommendations

Number	Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments
TGB-3	1	C	TGB	Generator	Spare Part	Purchase stator rewind kit. On budget for 2007-08 budget already	Jon-C		GE has been contracted to rewind both generators and supply set of spare bars.
TGB-5	1	C	TGB	Generator	Capital Project	Evaluate installing on-line generator flux probes and on-line partial discharge to monitor field and stator winding integrity.	Jon-C	0	Not justified, we can recognize a turn-to-turn short by vibration. Annual testing by contractor is a better option.
TGB-7	1	C	TGB	Generator	Maintenance	Evaluate the need of upgrading the Pole-to-Pole jumpers on the Unit 2 field.	Jon-C ~DONE	0	GE has indicated that there is NOT a new design available. We the best that there is.
TGB-9	1	C	TGB	Generator	Spare Part	Evaluate the purchase of spare T-12 and T-13 bearing insulation	Kelly Cloward	0	Spares on hand along with insulation for GE H2 seal casing
TGB-10	1	C	TGB	Generator	Spare Part	Evaluate the purchase of spare main leads for the generator We do not currently have any in stock.	Kelly Cloward	0	Purchased during Unit 1 2007 outage but, not installed. Currently in warehouse
TGB-14	1	C	TGB	Generator	Capital Project	Evaluate the capital project to install a new hydrogen monitoring system Parts are becoming difficult to obtain and it is not as accurate as it needs to be.	Dave Spence	$150,000	On the 2008-09 Capital Budget.
TGC-3	1	C	TGC	Seals & Drains	Capital Project	Possible purchase helium leak detection equipment. We have SF6 equipment but, it is too sensitive for most applications.	Dave Spence	$50,000	Not justified, we do not do enough testing to get good at it. Better option is to hire testing contractors when needed.
TGE-1	1	O	TGE	Generator Cooling	Capital Project	Investigate potential capital project to upgrade generator liquid level detectors	Dave Spence		
TGE-3	1	C	TGE	Generator Cooling	Spare Part	Evaluate the purchase of a Main Seal Oil Pump (MSOP) motor	Kelly Cloward	0	Min/max established for spare MSOP as well as Recirc Seal Oil Pump
TGE-4	1	C	TGE	Generator Cooling	Spare Part	Evaluate the purchase of a spare Emergency Seal Oil Pump (ESOP) motor	Kelly Cloward	0	Min/max established for spare motor
TGE-5	1	C	TGE	Generator Cooling	Spare Part	Evaluate the purchase of a spare stator cooling water pump	Kelly Cloward		Complete
TGF-2	1	C	TGF	Turbine Controls	Maintenance	Evaluate the purchase of enough EHC fluid for a complete change out to have in stock for emergencies.	Kelly Cloward	0	Sufficient stock exists in Salt Lake City and could be purchased on short notice in the event of an emergency. Purchasing a complete change is not necessary
APA-1	2	O	APA	120 Volt Power Supply	Maintenance	Install all spare circuit boards for UPSs into working units to prove the spare boards are good and have the right terminals on the boards	Wes-B	0	This suggestion has morphed into a bigger problem Different generations of boards have different terminal types making boards non-interchangable. We are looking at the entire spare issue
APA-5	2	O	APA	120 Volt Power Supply	Spare Part	Review tray cable quantities that are installed and then purchase adequate cable to cover a significant incident in which numerous cables were damaged.	Wes-B		This is a general item applying to all systems and not specifically tied to the Aux Power system.
APC-1	2	C	APC	480 Volt Power Supply	Spare Part	Review impact of loss of Helper Cooling Tower electrical equipment and develop plan if there is a disruption to the power system to the Electrical Building. We have no spare transformer, bus duct, main, or tie breaker for this gear.	Aaron-N	0	There is sufficient redundancy with the existing electrical system that the loss of one transformer would still provide half of the power to the other unit through a cross-tie which would be enough to still maintain full load A spare transformer is not justified here
APE-2	2	C	APE	6900 Volt Power Supply	Capital Project	Purchase and install Aux Transformer oil continuous dissolved gas analysis monitoring system.	Pam Bahr		Complete
APE-3	2	C	APE	6900 Volt Power Supply	Capital Project	Add more Aux Power distribution equipment monitor points into the PI systems for ease of remote monitoring of bus voltages, vars, harmonics, power factor, etc.	Nathan-C		Complete
APE-4	2	O	APE	6900 Volt Power Supply	Spare Part	Evaluate spare protective relay availability for BBC Switchgear cubicles	Pam Bahr		
APE-5	2	C	APE	6900 Volt Power Supply	Spare Part	Evaluate spare parts availability for one complete switchgear cubicle including PTs, devices, shutters, etc	Wes-B		We have enough spare breakers at this time that parts can be robbed or the whole breaker changed if needed No further action is justified
APE-6	2	O	APE	6900 Volt Power Supply	Spare Part	Review spare parts availability for DMAD power distribution system including transformer, pole switch hardware, and terminations	Wes-B		Onsite Reservoir holds 28 day supply of water with Well Pumps in service and all DMAD pumps
CAB-3	2	C	CAB	Compressed Air	Capital Project	Move the inlet of the air compressors away from the discharge of the dryers to reduce reentrainment of removed moisture.	Dean-W		Complete
CAB-8	2	C	CAB	Compressed Air	Spare Part	Maintain spare compressor cooler in ready to install condition	Gary-J		Complete

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Availability Improvement Project
List of Recommendations

Number	Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments
CAB-9	2	C	CAB	Compressed Air	Spare Part	Spare motor to compressor coupling	Jim Mitchell		Spare couplings are available with local suppliers.
CCE-2	2	C	CCE	Induced Draft	Capital Project	Upgrade ID Fan Vibration Monitoring System	Aaron-N		Complete
CCE-4	2	C	CCE	Induced Draft	Spare Part	Evaluate the capital purchase of a spare ID Fan Motor. Loss of one motor would result in derate and it would take over one year to get replaced.	Nathan Crop	$ 1,520,000	Placed on the 2008-09 capital budget but, rejected by staff due to insufficient justification
CCE-6	2	C	CCE	Induced Draft	Spare Part	Evaluate the purchase of a spare ID Fan Coupling This is a large coupling that may difficult to obtain. We do not have any spares in stock.	Kelly Cloward		Determined that failure of coupling is highly unlikely, not needed.
CCE-8	2	C	CCE	Induced Draft	Spare Part	Evaluate the purchase of a spare ID Fan Reactor	Nathan Crop		The failure of one reactor would not cause a reduction of unit load. Not justified
CHD-1	2	C	CHD	Silo Fill	Spare Part	Evaluate the purchase of a spare magnetic coupling for Conveyors 18A and 18B. We have a spare motor but, no coupling, it would take 3-6 months to fabricate.	Kelly Cloward		Cancelled, we have a spare fluid coupling that could be installed in its place in an emergency. No justified at this time
GTA-5	2	O	GTA	Generator Bus-Duct	Spare Part	Review spare parts for the Generator PT and Transformer PT & Surge cubicles	Wes-B		
HRC-1	2	C	HRC	Heat Rejection	Spare Part	Evaluate the purchase of spare blades for Helper Cooling Tower	Kelly Cloward		The loss of one fan will not jeopardize unit availability. Purchasing a spare sent is not justified
HRD-1	2	C	HRD	Circulating Water Make-Up	Capital Project	Upgrade variable frequency drives in all cabinets and control cooling tower basin level by varying the pump speed instead of through control valve.	Pam Bahr		Drives have been upgraded, complete
SGA-15	2	O	SGA	Steam Generator	Spare Part	Investigate an Assured Stocking Program with Alstom to afford IPSC better availability of small quantities of boiler tubes, a ready source for large quantity orders, and the ability to reduce on-site inventories.	Craig Stumph		Dean Wood is working on this with Purchasing
SGA-16	2	C	SGA	Steam Generator	Spare Part	Evaluate Boiler tube needs based on location of tubes in boiler with the goal of consolidating and reducing inventory.	Craig Stumph		Complete
SGA-19	2	C	SGA	Steam Generator	Predictive Maintenance	Develop a program to identify and test boiler and feedwater piping that would be subject to FAC	Craig Stumph		Inspection program has been developed.
TGA-3	2	C	TGA	Turbine	Capital Project	Evaluate Installing a 10-15 ton auxiliary hoist on turbine bay cranes that will lift small parts faster. Crane is often tied up during outage lifting small parts down to ground floor. The 40 ton auxiliary crane is very slow.	Dave Spence		Does not affect availability, but would greatly increase maintenance productivity. Travel time on the Aux hook is 5 minutes each way from deck to 1st floor. Rejected by Mike Alley
TGA-4	2	C	TGA	Turbine	Maintenance	Evaluate the schedule for replacing the LP turbine hood rupture discs	Kelly Cloward		Should be done at the next LP turbine overhaul. More a reliability issue, and would be inexpensive to accomplish. Scheduled for next LP Overhaul
TGA-7	2	C	TGA	Turbine	Predictive Maintenance	Evaluate phased array NDE testing on LP turbine rotor dovetail diaphragm dovetail fits	Phil Hailes		Phased array will be used at next oportunity.
TGA-8	2	C	TGA	Turbine	Maintenance	Review schedule for rebuilding control valve, stop valve and intercept valve control valves.	Dave Spence		Rebuild schedule for valves is adequate, but the steam chest inspection frequency should be evaluated-priority 2 based on ease of completion
TGA-10	2	C	TGA	Turbine	Spare Part	Evaluate the purchase of a spare main turbine turning gear spur gear	Kelly Cloward		Stocking a complete gear and bearing set Unit 2 TG will be overhauled spring of 2008
TGA-11	2	C	TGA	Turbine	Spare Part	Evaluate purchase of spare CRV valves parts.	Kelly Cloward		parts evaluation is complete
TGA-13	2	C	TGA	Turbine	Spare Part	Review gland exhauster spare parts	Kelly Cloward		complete
TGB-6	2	C	TGB	Generator	Spare Part	Evaluate spare 18-5 retaining rings in storage Should be NDE'd to make sure not damaged during removal and storage requirements should be verified.	Dave Spence		Can be used in an emergency
TGB-8	2	C	TGB	Generator	Capital Project	Evaluate generator protective relays, they are old technology and parts are becoming difficult to obtain.	Jon-C		Evaluation completed, project to replace relays is on the 10-year plan We have sufficient spare parts until then.
TGB-11	2	C	TGB	Generator	Spare Part	Vibration system has been upgraded with very few spare parts. Evaluate spare parts for the new Bentley system	Kelly Cloward		Complete
TGB-12	2	C	TGB	Generator	Spare Part	Evaluate the purchase of spare main bushings and clam shell connections for the generator.	Wes-B		Spares have been purchased
TGB-13	2	C	TGB	Generator	Spare Part	Evaluate the purchase of spare current transformers for the generator.	Wes-B		Complete

Availability Improvement Project
List of Recommendations

Number	Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments
TGC-1	2	O	TGC	Seals & Drains	Capital Project	Look at upgrading turbine below seat drain valves again We still have not found a reliable valve for this service.	Dave Spence		We are currently testing one valve
TGD-1	2	C	TGD	Turbine Lube Oil	Capital Project	Evaluate possible capital project to upgrade level indication on main Turbine Lube Oil Reservoir	Phil Hailes		On 2008-09 capital budget.
TGE-2	2	C	TGE	Generator Cooling	Maintenance	Establish PM to pull & clean stator cooling water strainer during regular intervals	Kelly Cloward		PM is being added to the outage list
APA-3	3	C	APA	120 Volt Power Supply	Predictive Maintenance	Create additional databases for easier access to predictive data such as oil sample data, vibration data, alignment data, and testing data.	Brook-P		Not practical due to the proprietary nature of each system
APA-4	3	O	APA	120 Volt Power Supply	Spare Part	Purchase complete spare switchboard interior for a PC Distribution panelboard.	Wes-B		This 120V system has a 600A rated bus. ITE fusible switchboards are obsolete.
APE-1	3	O	APE	6900 Volt Power Supply	Capital Project	Add viewing windows to switchgear lineups and switchgear loads to more fully be able to provide thermography scans on line	Wes-B		
APH-2	3	O	APH	DC Power Supply	Spare Part	Purchase complete spare switchboard interior for a DC Unit Battery Distribution panelboard	Wes-B		
API-2	3	O	API	AC Essential Service	Spare Part	Purchase complete spare switchboard interior for an Essentail AC Distribution panelboard	Wes-B		This 120/240V system has a 225A rated bus ITEfusible switchboards are obsolete
CAB-1	3	C	CAB	Compressed Air	Capital Project	Install additional isolation valves at the compressors to insure compressors can be maintained on-line	Dean-W		Complete
CAB-7	3	C	CAB	Compressed Air	Predictive Maintenance	Put dew point readings in common data base for trending and analysis	Brook-P		Complete
ECB-1	3	O	ECB	Closed Cycle Cooling	Predictive Maintenance	Set-up a program to inspect and eddy-current test critical cooling heat exchangers (EHC, Stator Cooling, BFPT Lube Oil, Air Compressor, etc)	Aaron-N		
GTB-2	3	O	GTB	Generator Transformer	Capital Project	Purchase and install new digital temperature monitoring system for installation on U1 & U2 GSU Transformer.	Jon-C		
HRA-1	3	C	HRA	Condensate	Spare Part	Evaluate the purchase of a spare Condensate Pump Motor	Aaron-N		Not justified
SGA-2	3	O	SGA	Steam Generator	Capital Project	Increase scope of inspection on Seal air fans and dampers.	Kelly Cloward		Inspections should be done each outage
SGA-3	3	C	SGA	Steam Generator	Capital Project	Install access door for Seal air fan damper inspections.	Kelly Cloward		Not justified
SGG-1	3	C	SGG	Main Steam	Maintenance	Replace main steam supply valves to Boiler feed pump turbines	Kelly Cloward		Not justified
SGG-1	3	C	SGG	Main Steam	Predictive Maintenance	Investigate the feasibility of performing Acoustic Emmission Testing on critical piping to identify areas for more focused NDE	Dean Wood		Technology is involving but , not ready for prime time
TGA-1	3	C	TGA	Turbine	Capital Project	Evaluate the capital project to upgrade the Intermediate Pressure turbines for increased efficiency	Tech Services		Cannot be justified
TGA-5	3	C	TGA	Turbine	Maintenance	Evaluate removal of machined shoulder on Unit 1 TE hydrogen seal area journal.	Dave Spence		Likely will not be an issue in the future
TGA-6	3	C	TGA	Turbine	Predictive Maintenance	Evaluate the purchase X-Ray spectrometer equipment for metallurgy testing. This would allow us to identify material properties for developing proper weld procedure for and QC of new parts	Phil Hailes		Not justified
TGA-9	3	C	TGA	Turbine	Maintenance	Perform an audit of all TIL's issued by GE to make sure we are in compliance. Document reasons for non-compliance if applicable. Prepare summary document for management tracking and information	Dave Spence		Completed by GE as part of Generator Rewind Project
TGA-12	3	O	TGA	Turbine	Spare Part	Purchase tooling for removal and installation of main control valve seats.	Kelly Cloward		Should be a maintenance item to have equipment available to complete
TGB-4	3	O	TGB	Generator	Capital Project	Evaluate upgrading the Stator Leak Monitoring System (SLMS) system, it has never worked as well as hoped. New versions are now available	Pam-Bahr		Scheduled to be replaced in 2010 as part of Generator Rewind Project,
TGC-2	3	O	TGC	Seals & Drains	Capital Project	Evaluate upgrading drip pot level switches. Mercury switches may not work when needed	Jerry Finlinson		
TGF-1	3	O	TGF	Turbine Controls	Capital Project	Evaluate a potential capital project to upgrade the EHC skid	Dave Spence		
SGA-4	4	I	SGA	Steam Generator	Capital Project	Install access door on rear wall of boiler backpass at middle bundle of superheat tubes, for inspection and repair access.	Dean Wood		
SGA-6	4	O	SGA	Steam Generator	Capital Project	Add One additional Drum safety valve to each unit	Dean Wood		
SGA-7	4	C	SGA	Steam Generator	Maintenance	Purchase a tube bending machine for the GSB shop to allow IPSC to make their own replacement tube panels	Will Lovell		Local contractor available, cannot be justified.

Priority 1 - Highest priority, it will receive consideration for immediate implementation or at next available budget cycle.

A. Suggestion is for Criticality Factor I System and implementation of the suggestion could have an immediate impact on system availability.

Status Codes

C = Complete
O = Open

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Availability Improvement Project
List of Recommendations

Number	Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments

impact on system availability.

B. Suggestion is for Criticality Factor 1 or 2 System and even though implementation may not have immediate impact on availability, it so easy or inexpensive to implement that it should be done as soon as possible.

Priority 2 - Medium priority, it will be considered for implementation in the next or future budget cycles as funds are available.

A. Suggestion is for Criticality Factor 2 System and implementation of the suggestion could have an immediate impact on system availability.

B. Suggestion is for Criticality Factor 3 or 4 System and even though implementation may not have immediate impact on availability, it so easy or inexpensive to implement that it should be completed as funds and time are available.

C. Suggestion is for Criticality Factor 1 System but, implementation would have only a moderate impact on system availability

D Suggestion is for Criticality Factor 3 or 4 System but, the impact on system availability is high.

Priority 3 - Low priority, suggestion will be retained on the tracking spreadsheet for future evaluation but, will not be considered for implementation at this time.

A Suggestion is for Criticality Factor 3 or 4 System and implementation of the suggestion could have a moderate impact on system availability

B. Suggestion is for Criticality Factor 1 or 2 System but implementation would have only a minor impact on availability or would have a moderate or high impact but, the cost of implementation is so high that it is difficult to justify

Priority 4- No priority, suggestion will be eliminated from the active tracking

I = Inactive

12/29/2010

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Availability Improvement Project
List of Recommendations
Converter Station

Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments
1	Complete	P1DC-H	Pole 1 HVDC Bus	Spare Part	1 complete disconnect switch, including insulator stacks and grounding switch for 1H/2H	Travis Smith	50,000	No Insulator Stacks all other parts available
1	Complete	P1DC-H	Pole 1 HVDC Bus	Spare Part	1 complete set of components for CCP 1H	Travis Smith		
2	Complete	COX	ICS Controls	Spare Part	1 complete set of circuit boards, terminal boards, and processor boards to replace any type of board required in control systems	Travis Smith		
2	Complete	COX	ICS Controls	Spare Part	1 complete set of transducers and meters to match any type used in control systems.	Travis Smith		
2	Complete	COX	ICS Controls	Spare Part	1 complete set of relays to match any type used in control systems	Travis Smith		
2	Complete	COX	ICS Controls	Spare Part	1 complete set of fiber optic terminals for DCOCT	Travis Smith		
2	Complete	P1AC	Pole 1 AC Yard	Spare Part	1 spare set of connectors for bus-work and 2 sets of spare connectors for each type of line drop	Travis Smith		
2	Open	P1AC	Pole 1 AC Yard	Spare Part	1 set of spare CVTs and CTs for each type needed.	Travis Smith	100,000	
2	Complete	P1FW	Pole 1 Fine Water	Spare Part	1 set of spare fittings for heat exchangers, pipes, pumps, and valves	Travis Smith		
2	Complete	P1FW	Pole 1 Fine Water	Spare Part	1 set of spare gaskets for heat exchangers.	Travis Smith		
2	Open	P1FW	Pole 1 Fine Water	Spare Part	1 set of spare valve handles for each type needed.	Travis Smith	2,000	
2	Open	P1AC	Pole 1 AC Yard	Predictive Maintenance	Install on-line transformer monitoring for Doble and DGA.	ICS		
2	Open	P1RW	Pole 1 Raw Water	Capital Project	Replace existing cooling towers due to end-of-life service.	ICS	350,000	In Progress
2	Complete	P1DC-H	Pole 1 HVDC Bus	Spare Part	1 set of each types of connectors for bus-work and 2 sets of spare connectors for each type of line connections.	Travis Smith		
2	Complete	P1DC-N	Pole 1 Neutral Bus	Spare Part	1 complete spare neutral disconnect switch	Travis Smith	10,000	No Insulator Stacks all other parts available
2	Complete	P1DC-N	Pole 1 Neutral Bus	Spare Part	1 spare insulator of each type used on neutral bus	Travis Smith	100,000	
2	Complete	P1VH	Pole 1 Valve Hall	Spare Part	1 set of each type of PEX tubes and connectors.	Travis Smith		
2	Complete	P1AC	Pole 1 AC Yard	Spare Part	1 spare set of bladders in N2 for each type used in conservators	Travis Smith		
2	Complete	SWE	AC Switchyard Equipment	Spare Part	1 set of spare conductor connectors for bus-work and 2 sets of spares for each type of line connection	Travis Smith		
2	Not Complete	SWE	AC Switchyard Equipment	Spare Part	1 complete set of spare CVTs and CTs for 345 kV, 230 kV, and 46 kV busses.	Travis Smith	100,000	
2	Partial	SWE	AC Switchyard Equipment	Spare Part	1 set of spare cable splice kits for all cable sizes	Travis Smith		
2	Partial	SWE	AC Switchyard Equipment	Capital Project	Purchase SF6 Gas Cart to capture and re-use SF6 gas	ICS	70,000	Existing Cart can be used with a compressor change out
3	Partial	APX	Auxiliary Power	Spare Part	1 complete set of spare circuit boards and other discrete components required to repair each type of battery charger	Travis Smith		In Progress
3	Partial	APX	Auxiliary Power	Capital Project	Replace all batteries/chargers due to end-of-life and obsolesence	Travis Smith	400,000	In Progress
3	Partial	P1DF	Pole 1 DC Filter	Spare Part	Take FB2 out of service and keep as cold spare for 12th or 24th harmonic tuned filter.	Travis Smith		Now used as hot spare
3	Partial	P1VH	Pole 1 Valve Hall	Predictive Maintenance	New Valve Test Unit	ICS	150,000	Low voltage test unit now being used
3	Partial	STA	AC Filter Banks	Spare Part	3 spare reactors for 11/13 sub-bank filter.	Travis Smith	150,000	Only one phase is now available
3	Complete	STA	AC Filter Banks	Spare Part	1 spare reactor for each type used in AC filter banks	Travis Smith		
3	In Design	STA	AC Filter Banks	Predictive Maintenance	Install monitoring equipment to measure on-line filter performance	ICS		Part of new control upgrade
3	Partial	STA	AC Filter Banks	Capital Project	Purchase capacitance bridge test unit to check capacitance of each sub-bank filter.	ICS	30,000	Fluke Meter 123 being used in interm
3	Partial	SWE	AC Switchyard Equipment	Spare Part	1 spare 345 kV disconnect	Travis Smith	50,000	No Insulator Stacks all other parts available

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Availability Improvement Project
List of Recommendations
Converter Station

Priority Code	Status Code	System Code	System Description	Type	Description of Suggestion	Assigned To:	Estimated Cost	Comments
3	Not Complete	SWE	AC Switchyard Equipment	Spare Part	1 spare 46 kV disconnect	Travis Smith	25,000	
4	Not Complete	P1FW	Pole 1 Fine Water	Capital Project	Modify crane/hoist rails to positions directly overhead heavy equipment	ICS		
4	Partial	P1RW	Pole 1 Raw Water	Capital Project	Modify crane/hoist rails to positions directly overhead heavy equipment	ICS	5,000	Pole 1 Complete Pole 2 Not Complete
4	Complete	P1FW	Pole 1 Fine Water	Capital Project	Install bypass fill piping and small ball valve on filter tank.	ICS		
4	Partial	SWE	AC Switchyard Equipment	Spare Part	1 complete phase spare of Mitsubishi 345 kV breaker	Travis Smith	200,000	Bushings available, tank is not

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Generating Station

AP **Auxiliary Power Supply**

APA	AC Power Supply (120 V)
APC	AC Power Supply (480 V)
APE	AC Power Supply (6900 V)
APH	DC Power Supply
API	Essential Service AC
APJ	Essential Service DC
APK	Emergency Generation

AS **Ash and Scrubber Solids**

ASA	Bottom Ash
ASB	Fly Ash
ASC	Boiler Hopper Ash
ASD	Pulverizer Rejects
ASE	Scrubber Solids
ASF	Combustion Waste Handling and Storage

BM **Bulk Materials**

BMA	Scrubber Additive Receiving
BMB	Scrubber Additive Storage and Reclaim
BMC	Scrubber Additive Preparation

BS **Buildings and Structures**

BSA	Generation Building
BSB	Air Quality Control Building
BSC	Control Center Building
BSE	Security Building
BSH	Circulating Water Pump Building
BSI	Coal Handling Buildings
BSK	Water Treatment Buildings
BSM	Utility Service Building
BSN	Ash Water Recliam Structure
BSP	Sludge Conditioning Building
BSU	Miscellaneous Yard Buildings

CA **Compressed Air**

CAA	Service Air
CAB	Control Air

CC **Combustion Gas Cleaning and Exhaust**

CCA	Chimney
CCB	Particulate Removal
CCC	Desulfurization
CCD	Combustion Gas Reheat
CCE	Induced Draft

CG **Compressed Gas Storage**

CGB	Carbon Dioxide Storage

CH **Coal Handling**

		CHA	Coal Unloading
		CHB	Coal Stock-Out and Reclaim
		CHD	Coal Silo Fill
		CHE	Coal Sampling and Weighing
		CHF	Coal Dust Control
CM	**Communications**		
		CMA	Plant Communication
CO	**Control**		
		COA	Coordinated Control (DCS)
		COB	Load Control
		COC	Unit Protection
		COF	Control and Multi-System Panels
EC	**Equipment Cooling**		
		ECA	Auxiliary Cooling Water
		ECB	Closed Cycle Cooling Water
EE	**Electrical**		
		EEA	Freeze Protection
FO	**Fuel Oil**		
		FOA	Fuel Oil Receiving and Storage
		FOB	Fuel Oil Supply
FP	**Fire Protection**		
		FPA	Generation Building Fire Protection
		FPB	AQCS Building Fire Protection
		FPC	Control Building Fire Protection
		FPE	General Services Fire Protection
		FPI	Coal Handling Fire Protection
		FPK	Water Treatment Fire Protection
FW	**Feedwater**		
		FWA	Boiler Feed
		FWB	Boiler Feed Pump Injection
		FWC	Condensate
		FWD	Condensate Polishing
		FEW	Cycle Chemical Feed
		FWF	Cycle Make-up and Storage
GT	**Generator Terminal**		
		GTA	Generator Bus Duct
		GTB	Generator Transformer
HR	**Cycle Heat Rejection**		
		HRA	Condensing
		HRB	Condenser Air Extraction
		HRC	Circulating Water
		HRD	Circulating Water Make-Up
		HRE	Circulating Water Chemical Feed

		HRF	Condenser Cleaning
INA	**Information**		
		INA	Information Computer (DCS)
		INB	Annunciation (DCS)
		IND	Vibration Monitoring
LT	**Lighting**		
		LTC	Control Building Lighting
PM	**Plant Maintenance**		
		PMB	Shutdown Corrosion Protection
		PMC	Vacuum Cleaning
PP	**Primary Power Supply**		
		PPA	Substation
		PPB	Contingency Arming Testing
PS	**Auxiliary Steam**		
		PSA	Auxiliary Steam Supply
SA	**Sampling and Analysis**		
		SAA	Combustion Gases Sampling an Analysis
		SAC	Steam Cycle Sampling and Analysis
SC	**Space Conditioning**		
		SCA	General Building Space Conditioning
		SCB	AQCS Building Space Conditioning
		SCC	Control Building Space Conditioning
		SCE	General Services Building Space Conditionin
SG	**Steam Generation**		
		SGA	Steam Generator
		SGA	Tube Leaks
		SGA	Pulverizers
		SGA	Drum Safeties
		SGB	Combution Air Supply
		SGC	Air Preheat
		SGE	Igniter Fuel
		SGF	Boiler Vents and Drains
		SGG	Main Steam
		SGH	Burner and Mill Controls
		SGI	Soot Blowing
		SGJ	Reheat Steam
		SGK	Temporary Blow out
ST	**Site**		
		STD	Fencing and Security
		STG	Site Fire Protection
TE	**Turbine Extraction**		
		TEA	High Pressure Extraction

		TEB	Low Pressure Extraction
		TEC	Extraction Traps and Drains
		TED	High Pressure Drains
		TEE	Low Pressure Heater Drains
TG	**Turbine Generator**		
		TGA	Turbine
		TGB	Generator and Excitation
		TGC	Turbine Seals and Drains
		TGD	Turbine Lube Oil
		TGE	Generator Cooling and Purge
		TGF	Turbine Control and Instrumentation
WS	**Water Supply and Storage**		
		WSA	Surface Water Supply
		WSB	Well Water Supply
		WSC	Service Water
		WSE	Fire Protection Water Supply and Storage
		WSG	Scrubber Makeup Water
WT	**Water Treatment**		
		WTA	Circulating Water Makeup Treatment
		WTB	Service Water Treatment
		WTD	Cycle Makeup Treatment
WW	**Water Collection and Treatment**		
		WWA	Chemical Waste Drainage and Treatment
		WWB	Sanitary Drainage and Treatment
		WWC	Wastewater Collection and Treatment
			Other
			Combustion Gas Reheat (Water Contam)

Converter Station

Converter Station

APX	**Auxiliary Power ICS**		
		APX-A	120/240 V Power
		APX-C	480 V Power
		APX-E	4.16 kV Power
		APX-N	46 kV Power
B1DC	**Bipole Common - Electrode**		
		B1DC-O	Bipole Equipment to Electrode
		B1DC-E	Bipole Electrode and Line
BSX	**Buildings and Structures**		
		BSX-0	Valve Hall and Auxiliary Building
		BSX-1	Relay House
		BSX-2	Service Building
		BSX-3	Cooling Tower Building
		BSX-4	Control Building
		BSX-5	AC Filter Building

COX	**ICS Controls**		
	COX-B	COX-B	Bipole Controls
	COX-1	COX-1	Pole 1 Controls
	COX-2	COX-2	Pole 2 Controls
	COX-ST	COX-ST	Station Controls
	COX-STA	COX-STA	AC Filter Bank Controls
MNT	**Station Monitoring System**		
		MNT-0	Access and Video Monitoring
P1DC	**Converter Station Pole 1**		
		P1DC-H	High Voltage Bus
		P1DC-N	Neutral Bus
		P1DF	Pole 1 DC Filters
		P1VH	Pole 1 Valve Hall
		P1AC	Pole 1 AC Yard
		P1RW	Raw Water Cooling
		P1FW	Fine Water Cooling
P2DC	**Converter Station Pole 2**		
		P2DC-H	High Voltage Bus
		P2DC-N	Neutral Bus
		P2DF	Pole 1 DC Filters
		P2VH	Pole 1 Valve Hall
		P2AC	Pole 1 AC Yard
		P2RW	Raw Water Cooling
		P2FW	Fine Water Cooling
STA	**Station AC Filters**		
		STA 1	AC Filter Bank 1
		STA 2	AC Filter Bank 2
		STA 3	AC Filter Bank 3
SWE	**Station AC Switchyard Equipment**		
		SWE-0	345 kV Bus 1 and 2
		SWE-1	B-Rack 46 kV Breakers and Equipment
		SWE-2	Bank M Equipment
		SWE-5	Position E5 Equipment
		SWE-6	Position E6 Equipment
		SWE-8	Position E8 Equipment
		SWE-9	Position E9 Equipment
		SWE-10	Position E10 Equipment
		SWE-11	Position E11Equipment
		SWE-12	Position E12 Equipment
		SWE-13	Position E13 Equipment

Unit 1	Unit 2	Station	Redundancy Factor	Criticality Factor
35.04	10.26	45.3		
2.96		2.96		
2.37	10.26	12.63		
28.54		28.54		
1.17		1.17		
	6.58	6.58		
	6.58	6.58		
	6.35	6.35		
		0		
	6.35	6.35		
	9.48	9.48		
	7.43	7.43		
	2.05	2.05		
0				
6.01	1.96	7.97		

6.01	1.96	**7.97**
12.66	**53.62**	**66.28**
12.66	53.62	**66.28**
206.92	**109.05**	**315.97**
189.54	109.05	**298.59**
17.38		**17.38**
183.69	**221.98**	**405.67**
157.59	46.56	**204.15**
26.1	175.42	**201.52**
75.05	**92.5**	**167.55**
51.65	92.5	**144.15**
0		
23.18		**23.18**
0.22		**0.22**

1.5		**1.5**
1.5		**1.5**

ıg

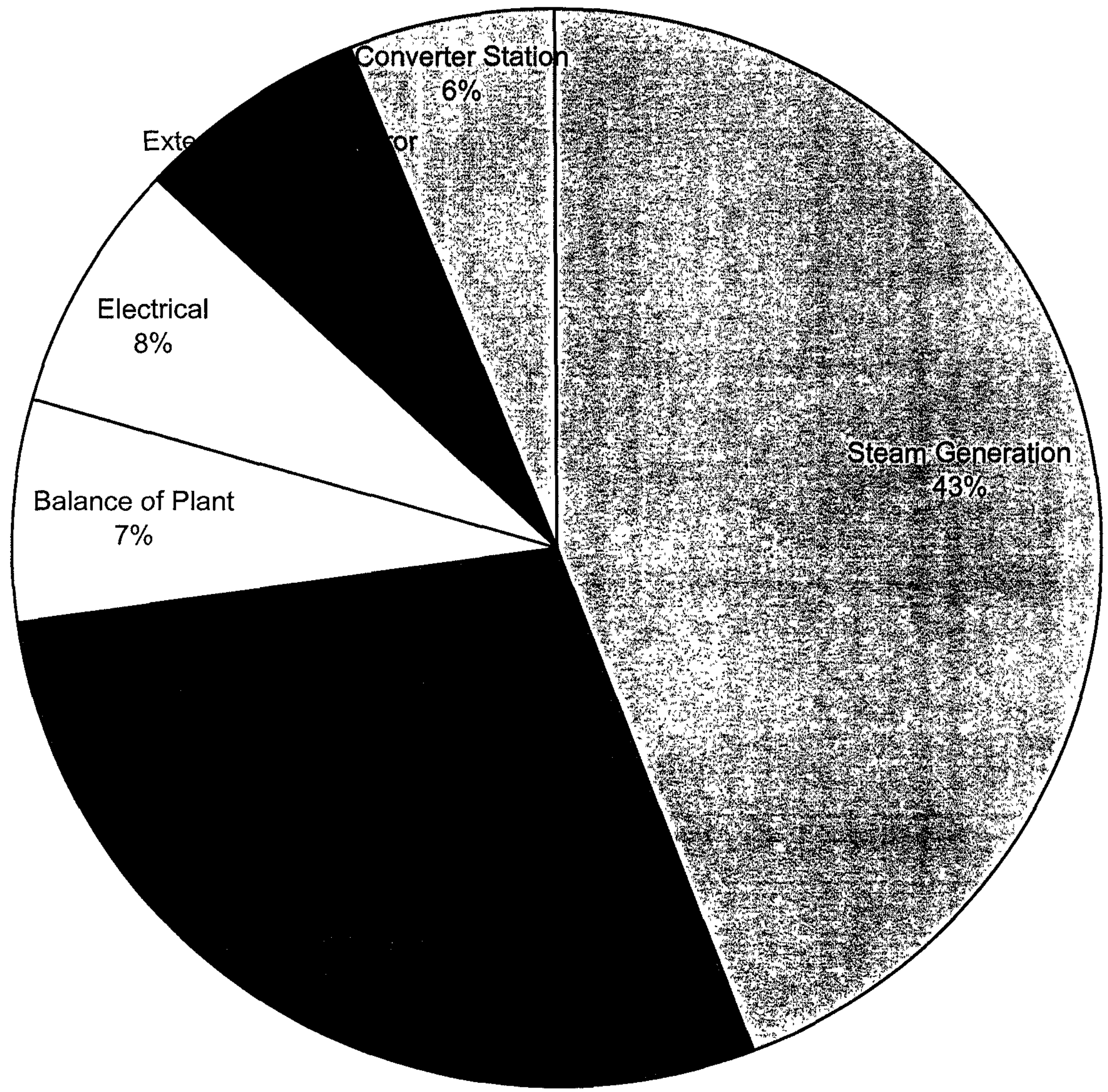
1723.07	**1546.87**	**3269.94**
22.55		**22.55**
1415.34	1094.12	**2509.46**
26.55	26.62	**53.17**
52.62	24.73	**77.35**
49.59	65.27	**114.86**
	63.55	**63.55**
111.72	190.03	**301.75**
44.7	23.15	**67.85**
	45.38	**45.38**
	14.02	**14.02**

10.91		**10.91**

8.28		**8.28**
0.05		**0.05**
2.58		**2.58**
725.55	**1375.66**	**2101.21**
395.83	25.69	**421.52**
241.89	1196.46	**1438.35**
5.16		**5.16**
5.52		**5.52**
77.15	153.51	**230.66**

14.63

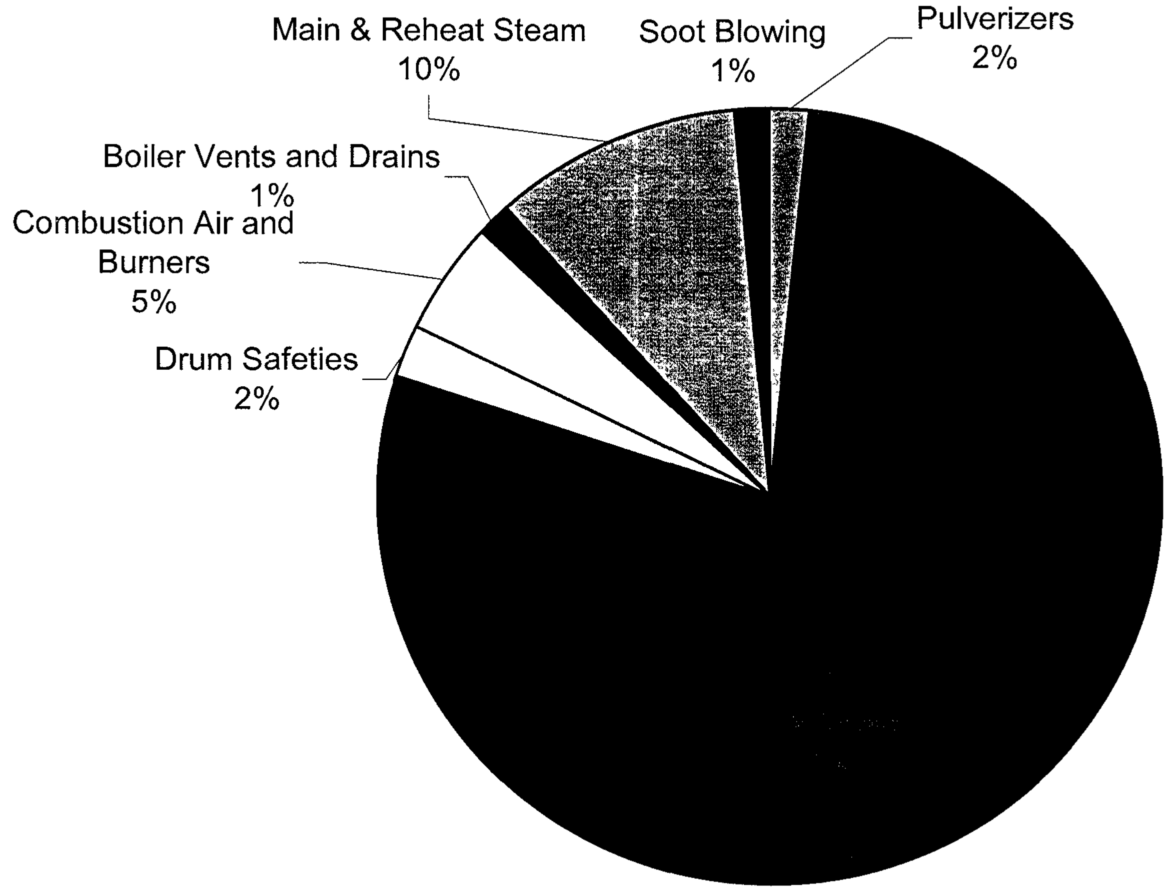
IGS
Loss of Availability by Major System



Includes all generation lost except for Planned Outages and Planned Derates.

Steam Generator Losses by Subsystem

(Percentage of all Steam Generator Losses of Equivalent Availability)



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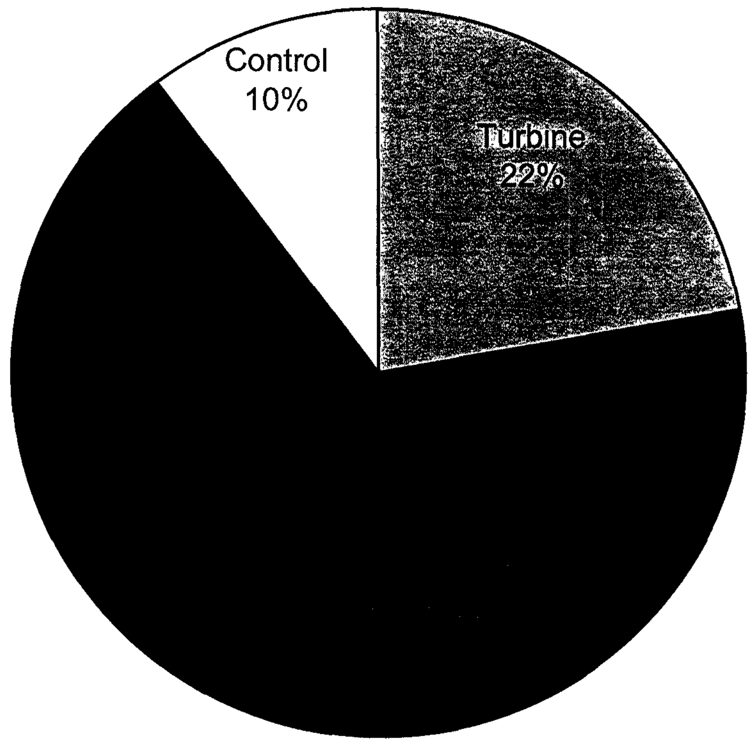
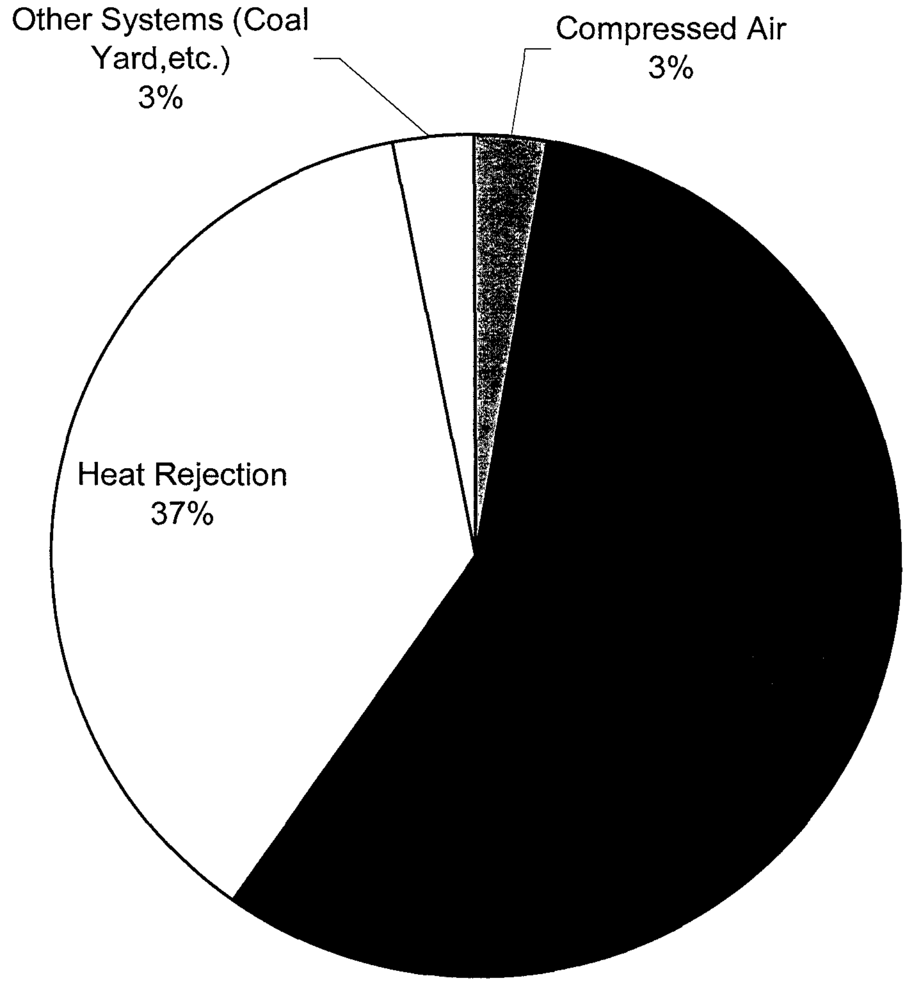
Turbine Generator Losses by Subsystem

(Percentage of all Turbine-Generator Losses of Equivalent Availability)



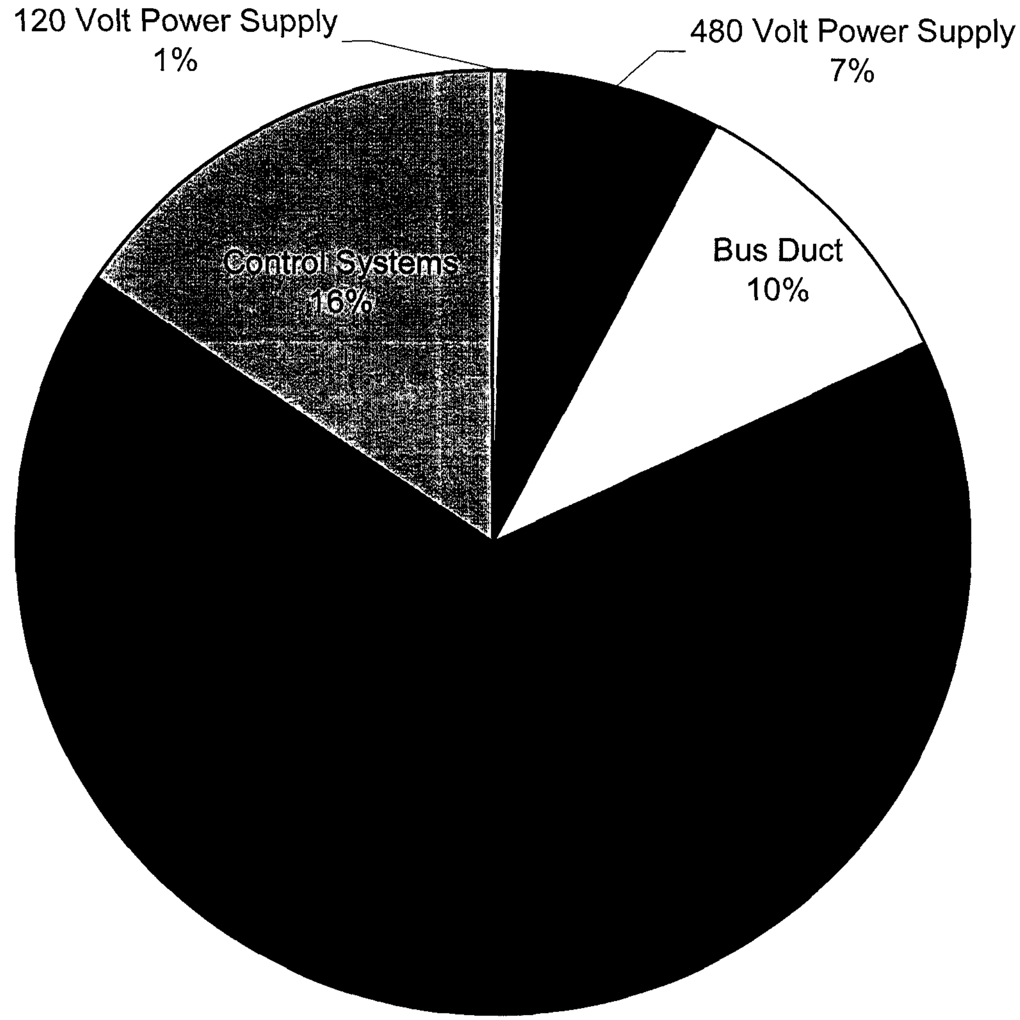
Balance of Plant Systems

(Percentage of Total Equivalent Availability Losses by Subsystem)



Electrical Systems Losses of Availability

(Percentage of Total Equivalent Availability Losses by Subsystem)



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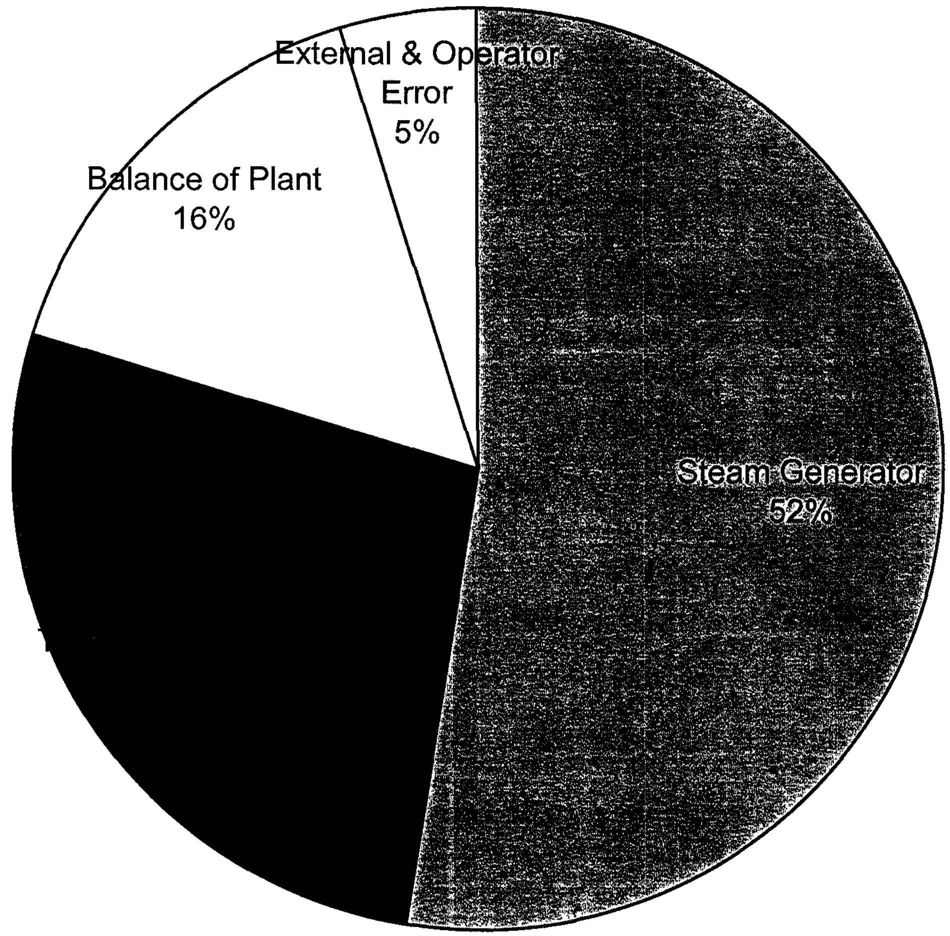
NERC-GADS Fossil Steam Plant Data

(1995-1999, All Unit Sizes, All Fuels, Average size approx. 300 MW)



Total Plant	
Steam Generation	3300
Turbine Generator	2129
Balance of Plant	493
Electrical	559
External and Op. Error	513
Converter Station	459

SG	U1	U2	Station	
Pulverizers	22.55	31.93	**54.48**	
Tube Leaks	1437.89	1094.12	**2532.01**	
Drum Safeties	52.62	26.65	**79.27**	
Combustion Air and Burners	66.57	82.25	**148.82**	
Boiler Vents and Drains	0	45.93	**45.93**	
Main & Reheat Steam	111.72	220.68	**332.4**	Includes Attemperators
Soot Blowing	0	45.38	**45.38**	

TG	U1	U2	Station
Turbine	425.8	49.03	**474.83**
Generator and Excitation	241.69	1196.46	**1438.15**
Control	70.18	146.24	**216.42**

Balance of Plant	U1	U2		
Compressed Air	2.1	13.4	15.5	
Feedwater	219.26	94.73	313.99	31.83
Heat Rejection	71.56	133.27	204.83	26.02
Other Systems (Coal Yard,etc.)	8.05	8.54	16.59	

Electrical			
120 Volt Power Supply	3.83	0	**3.83**
480 Volt Power Supply	29.74	9.54	**39.28**
Essential Service	1.17	0	**1.17**
Bus Duct	9.43	46.62	**56.05**

Generator Step-up Transformer	183.43	188.58	**372.01**
Control Systems	44.28	42.71	**86.99**

EPRI Data

Steam Generator	633.2
Turbine-Generator	327.99
Balance of Plant	187.99
External & Operator Error	56.69